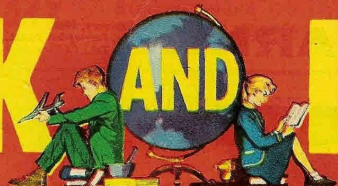


LOOK AND LEARN

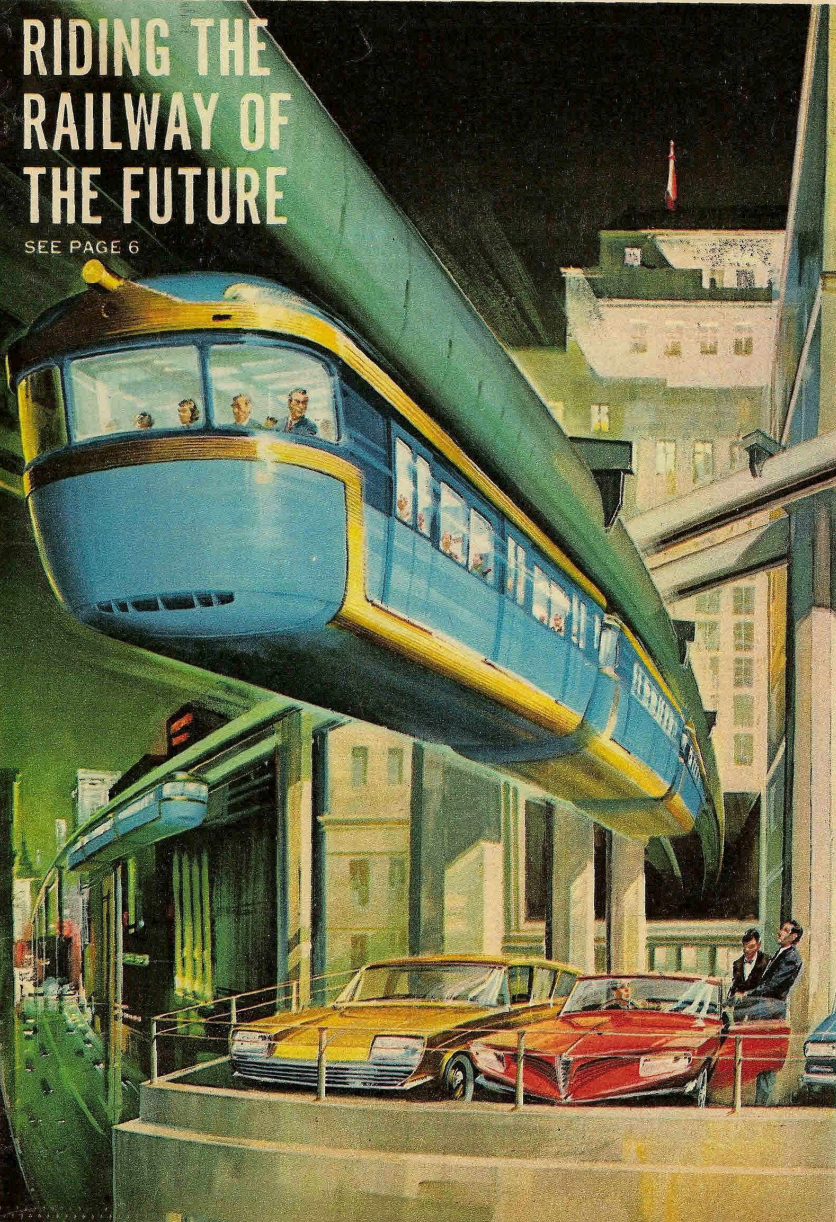


No. 56, 9th FEBRUARY 1963

EVERY MONDAY—PRICE ONE SHILLING

RIDING THE RAILWAY OF THE FUTURE

SEE PAGE 6



HISTORICAL COSTUMES AROUND THE WORLD



ANGONI MUSICIAN (AFRICA)

SWAHILI WOMAN (AFRICA)



UGANDA MAN (AFRICA)

KENYA WARRIOR (AFRICA)



TARKWA WOMAN (AFRICA)

KIKUYU GIRL (AFRICA)

THIS MODERN AGE

Can 100-miles-an-hour Monorails solve the travel problems of traffic-jammed cities? Germany answered "yes" to that question over sixty years ago!

TRAINS IN THE SKY

PASSENGER trains running on single overhead tracks at more than 100 miles an hour may be the only answer to the traffic problems of Britain's overcrowded cities.

There are two different kinds of monorail, as this system of transport is called. In one, the cars hang down from a track raised high above the ground.

In the other they rest on the single central rail, and are kept upright either because their centre of gravity is below the top of the rail, or they use a gyroscope which automatically keeps them upright.

The earliest monorails were of the supported type, the first being built in 1824 to carry goods in the London docks. Passengers were carried by monorail in 1877 between Bradford and Gilmore in Pennsylvania. But this line, like a similar one on Coney Island, New York, had only a short life. A ten-mile freight line was opened in Ireland in 1888 and ran until 1924. The first important monorail system for passengers did not come until 1900.

This was the Wuppertal line in Germany which has carried more than 600 million

passengers—and is still carrying them! Its nine miles of track traverse a part of the industrial Ruhr, about two-thirds being suspended above the River Wupper and the rest above city streets.

The Railplane

STEAM, electricity and diesel engines have all been used on monorails, while about thirty years ago a Scottish engineer, George Bennie, built a short stretch of demonstration line outside Glasgow for his "Railplane," which hung from an overhead track and could be moved at great speeds by airscrews fore and aft.

Like many other monorail systems for which short lengths of track have been built, it was too unconventional to gain support.

Americans had a chance to see a Monorail in action at last year's Seattle Fair.



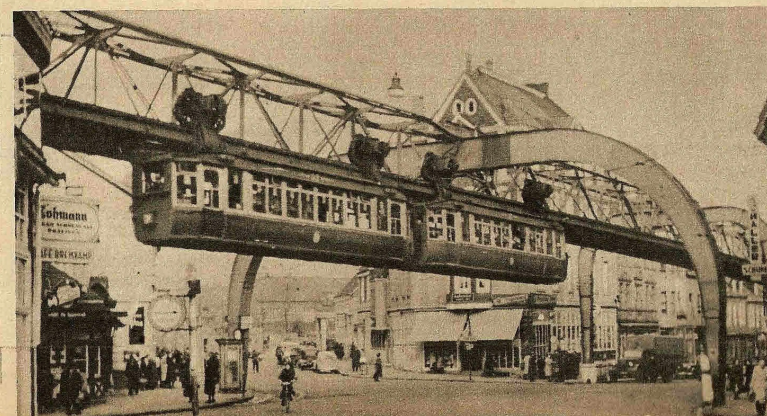
But since the end of the last war engineers have developed new ways of suspending or supporting monorail cars. Rubber-tyred cars have been built to give less noisy operation; and further demonstration railways have been built in Germany, France and the United States.

The greatest advantage of the monorail is that it can carry passengers above streets that are already densely packed with traffic, and more than one scheme has been put forward for such a link between Victoria Station and London Airport, fifteen miles away.

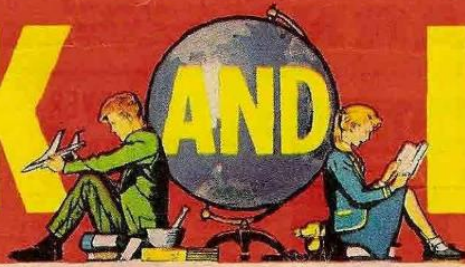
Cars would run above the western outskirts of London and then above the Great West Road, carrying passengers at a maximum of seventy miles an hour and covering the complete distance in fifteen minutes.

62—and still going strong!

When this picture was taken in 1951 the Wuppertal Monorail was celebrating its fiftieth birthday. It has now carried over 600 million passengers and proved a great success—but the rest of the world has not followed its example.



LOOK AND LEARN



No. 57, 16th FEBRUARY 1963

EVERY MONDAY—PRICE ONE SHILLING



**BRITAIN'S
FEARLESS
FIRE
FIGHTERS**

SEE PAGE 22

**HISTORICAL
COSTUMES
AROUND THE
WORLD**



SOLOMON
ISLE
WARRIOR



BRÉ MAN
(BURMA)



BRÉ WOMAN
(BURMA)



GHANAIAN
MAN

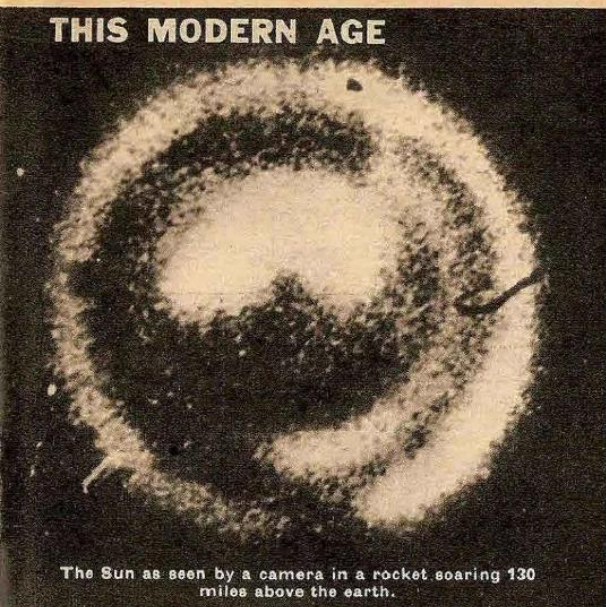


WOMAN OF
SUSARAT
(INDIA)



PARSEE
GIRL
(INDIA)

THIS MODERN AGE



The Sun as seen by a camera in a rocket soaring 130 miles above the earth.

TELESCOPE IN SPACE

*Down on the ground a scientist will
photograph the planets with
a camera floating miles above him*

THE world's largest telescope, the giant 200-inch wide reflector at Mount Palomar, California, can "see" an object only a few inches wide from a distance of 1,000 miles.

Yet even this enormous power of magnification is not as much as astronomers want for exploring the universe.

The atmosphere surrounding our Earth has serious effects upon the astronomers' observations of the Sun, the Moon and the planets.

This is because the atmosphere blurs and

distorts distant objects seen through telescopes on the ground.

Most of us have seen the way in which the Sun or Moon can sometimes appear hazy and less distinct than usual.

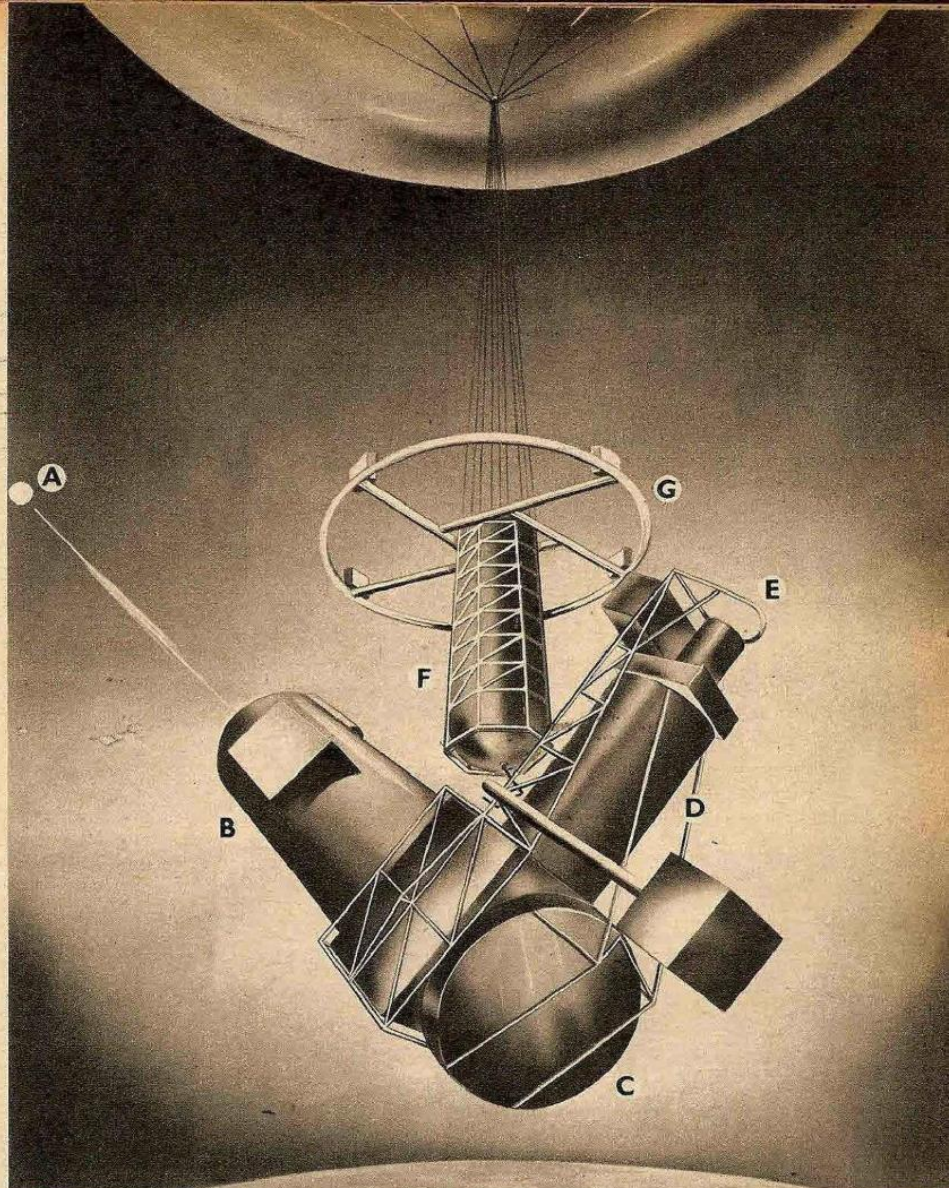
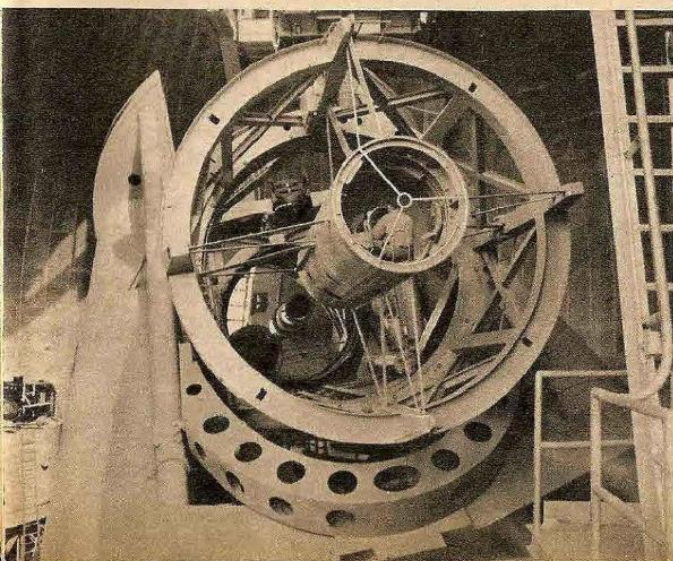
This year astronomers hope to get a "new look" at the planets, unhampered by the Earth's atmosphere.

They are going to send up a balloon to carry a telescope to a height of 80,000 feet above the Earth.

From that height, where most of the blurring effect of the atmosphere will be avoided, astronomers hope to obtain photos of the planets with a clarity never before achieved.

Two years ago scientists tried out this idea with a

The giant telescope at Mount Palomar. It weighs a thousand tons but is so delicately balanced that it moves at the touch of a finger. If you look closely, you can see an astronomer loading the camera in the tube with film. This gives you a good idea of the size of the world's largest telescope. But even the Mount Palomar telescope cannot "see" clearly enough for modern astronomers.



How the balloon telescope will observe and record information about the planets. Light from a planet A passes through a tube B on to a mirror C. The light is reflected by the mirror and focused by lenses through a tube D on to the camera E. The framework F contains the equipment which, controlled by radio signals from the ground, points the telescope and works the camera. The wheel G, with four weights on its rim, acts like a flywheel and keeps the telescope steady in space.

camera placed in the nose of a high-altitude rocket. The photographs showed that the Sun was giving off bursts of X-rays.

Fortunately the Earth's atmosphere prevents this radiation from harming us.

The telescope to be sent up by balloon has a 36-inch diameter mirror mounted in a long tube. The mirror will collect the light from Mars or Venus and focus it, through a system of lenses, on to a photographic film.

The focusing of the telescope and the operation of the camera will be controlled by signals radioed to the balloon by transmitters on the ground.

To bring the telescope back to Earth, a radio signal will open a valve on the balloon envelope. This will release gas and reduce the balloon's lifting power so that it comes down to a height of 5,000 feet from the Earth. A fleet of helicopters will then remove the telescope and camera and bring them to the ground.

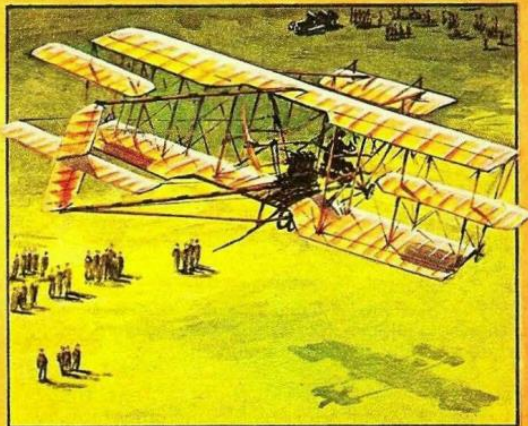
LOOK AND LEARN

No. 177, 5th JUNE 1965

EVERY MONDAY, 1s. 3d.



1 Called the "Southern Cross," this gallant little monoplane flew from Ireland to Newfoundland.



3 "The Flying Cathedral" was the name of this legendary aircraft.



5 The first ever non-stop flight across the Atlantic was made in this aircraft.

OUR COVER QUIZ

These famous aircraft were flown by the pioneer aviators shown below. Can you say which pilots flew which machines?



JIM MOLLISON



KINGSFORD SMITH



AMY JOHNSON



AMUNDSEN



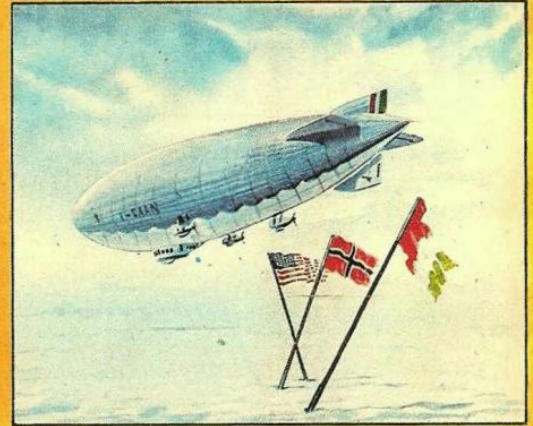
S. F. CODY



ALCOCK AND BROWN



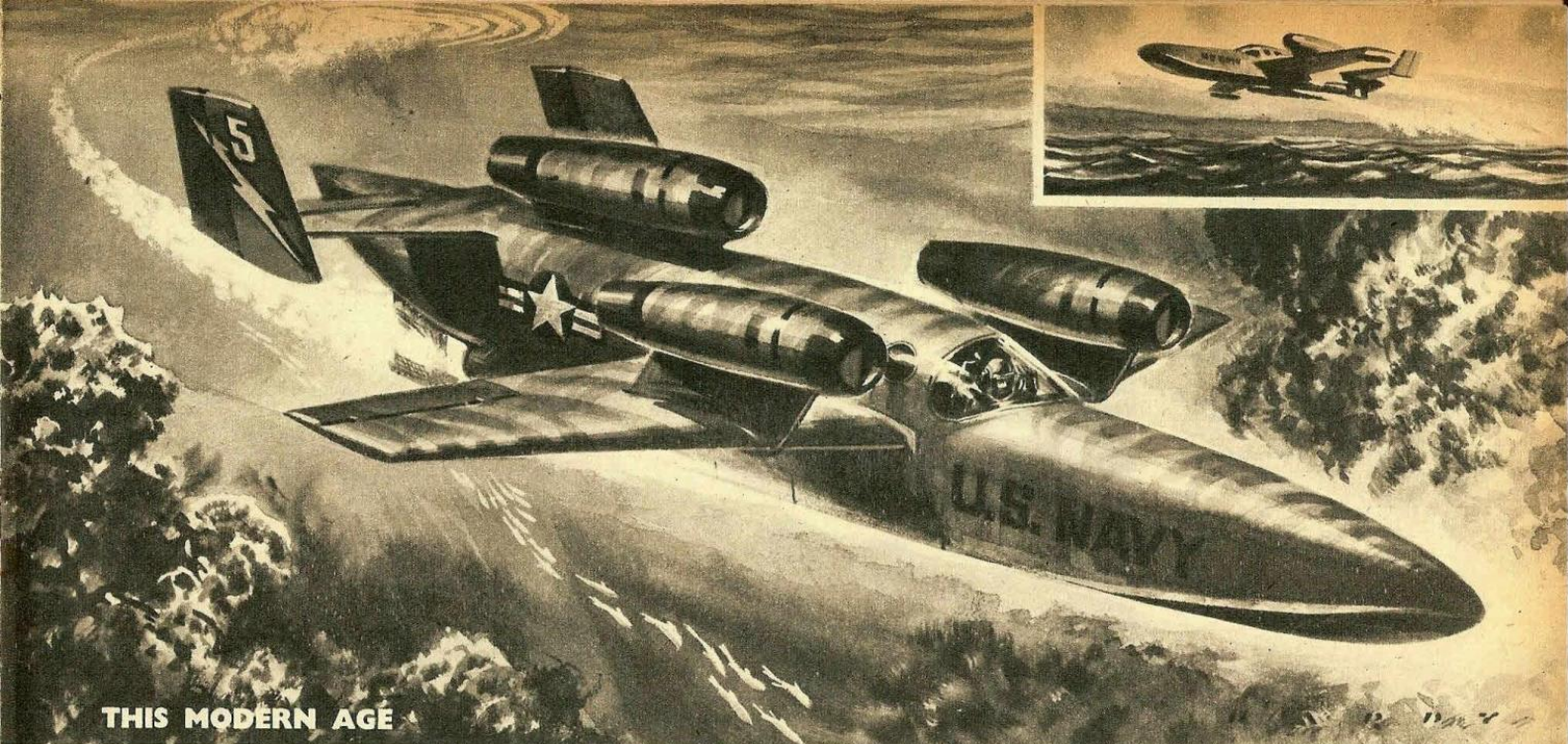
2 A famous pre-war pilot flew the Atlantic Ocean in this small cabin machine.



4 This airship made a successful flight to the North Pole in 1926.



6 A world famous pilot flew alone from England to Australia in this aeroplane.



THIS MODERN AGE

With its jet engines sealed, the Sub-Plane cruises under water. Inset above: A sea take-off using a retractable hydro-ski.

A FLYING SUBMARINE

This air-to-underwater craft is now being built

WHEN man first designed a submarine, critics said that that kind of craft belonged very much to the future. They said the same when the aeroplane was first designed. And until recently the suggestion that a craft which combined the qualities of both could be built successfully would have met with the same objection.

But suddenly the future comes very close, for after a six-months study American experts decided that such a craft is feasible and practical. What is more, plans have been prepared, and though most of the details are secret, some information has been released.

The Sub-Plane, as they call it, will look something like a flying boat, with three turbo-jet engines mounted on the wings and rear fuselage, the latter for cruising and the former for take-off assistance. There will be a hydro-ski of the type used on hydrofoil craft already in use, capable of being retracted.

Nothing unusual there, so far as air flight is concerned, but what happens when the journey continues under the sea?

Naturally the jet engines will have to be sealed so that they become completely watertight, and "controlled sinking" will be achieved by flooding tanks as in ordinary submarine practice.

Underwater propulsion will be by a battery-driven electric motor operating a shrouded propeller at the

bottom of the fuselage, and it is estimated that the ordinary flight controls will enable the Sub-Plane to be steered under water.

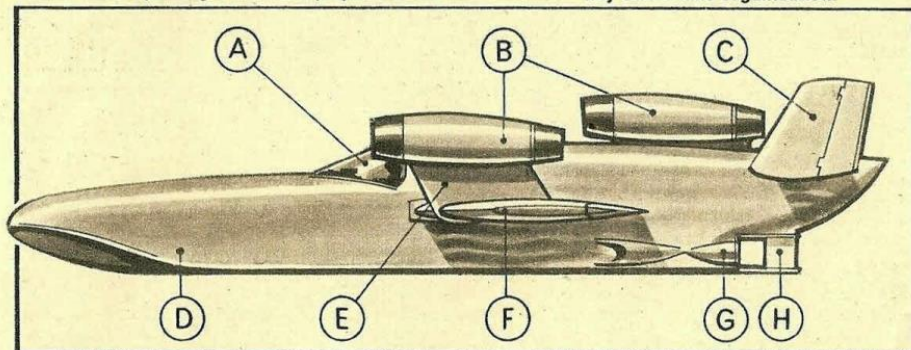
The emphasis of the whole project is, of course, that this would be a useful weapon of war; that is why full details are lacking. No doubt a beginning would be made with a small craft, but larger ones could develop from it.

Initial speeds, as announced, are that the Sub-Plane will fly at up to 500 miles an hour, but one can well imagine that this will soon be exceeded.

One problem is to provide escape gear in case of trouble, suitable for use either in the air or under the sea, and the news is that the designers have solved this problem.

The whole project is to be developed by the Convair organization in collaboration with the Electric Boat Division of the General Dynamics company.

On the right illustrations show three possible developments of the Sub-Plane. At top, for secret landings and commando attack operations. Centre: Underwater beacons might be installed for navigational purposes. At bottom: Underwater repair and rescue of submarines would be an important part of any Sub-Plane organization.



MAIN FEATURES OF THE SUB-PLANE

A, Control cockpit and cabin space. B, Jet engines for flight power. C, Tail assembly with elevator and rudder flying controls. D, Streamlined flying-boat type hull with retractable hydro-ski for water take-off and surface cruising. E, Wing engine pylons. F, Wing with aileron flying control. G, Shrouded underwater propeller. H, Underwater rudder.



LOOK AND LEARN

No. 182, 10th JULY 1965

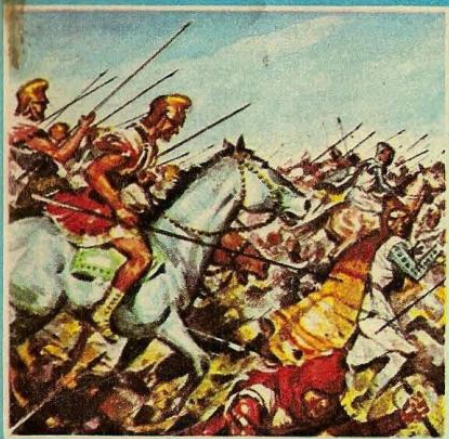
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COVER QUIZ

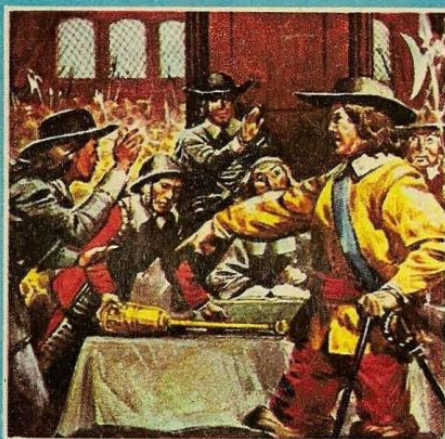
WHO WAS IN COMMAND?

Identify these scenes and link them with the leaders shown below.

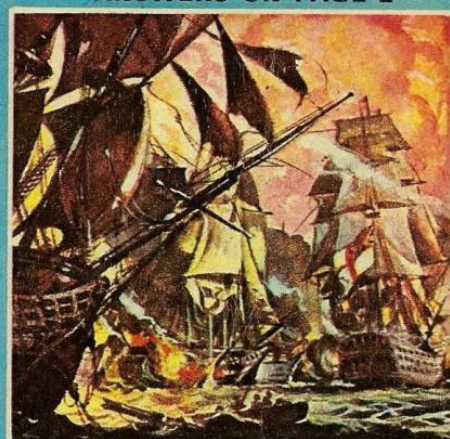
ANSWERS ON PAGE 2



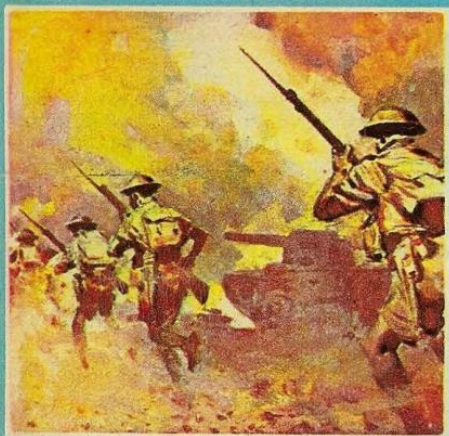
1 Here is the mighty Persian army in full flight. Who is leading the attack?



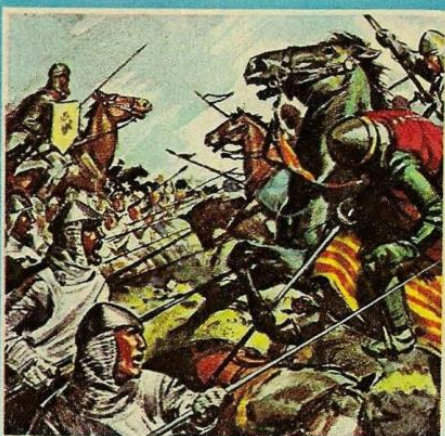
2 "Take away these baubles." Whose imperious command was this?



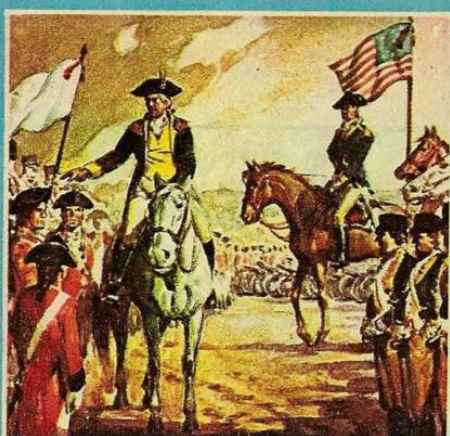
3 A naval hero was killed at this battle. What was his name and the occasion?



4 The second World War and a desert victory. Who led the British troops and where was it?



5 English invaders were beaten at this famous Scottish battle. Who led the Scots?



6 America's War of Independence ends. Can you name the defeated commander of the British forces?



A



B



C



D



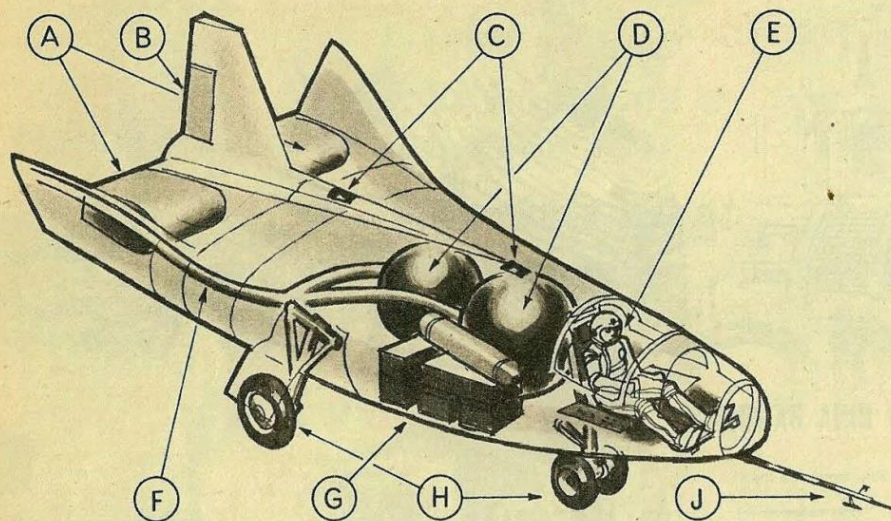
E



F

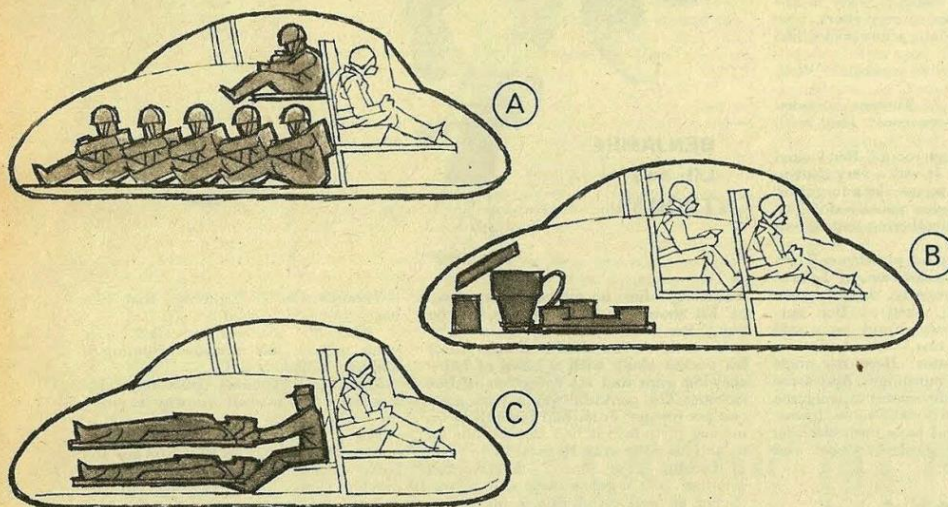
First of a new series on the latest developments, by land, sea and air

WHAT'S NEW IN THE AIR?



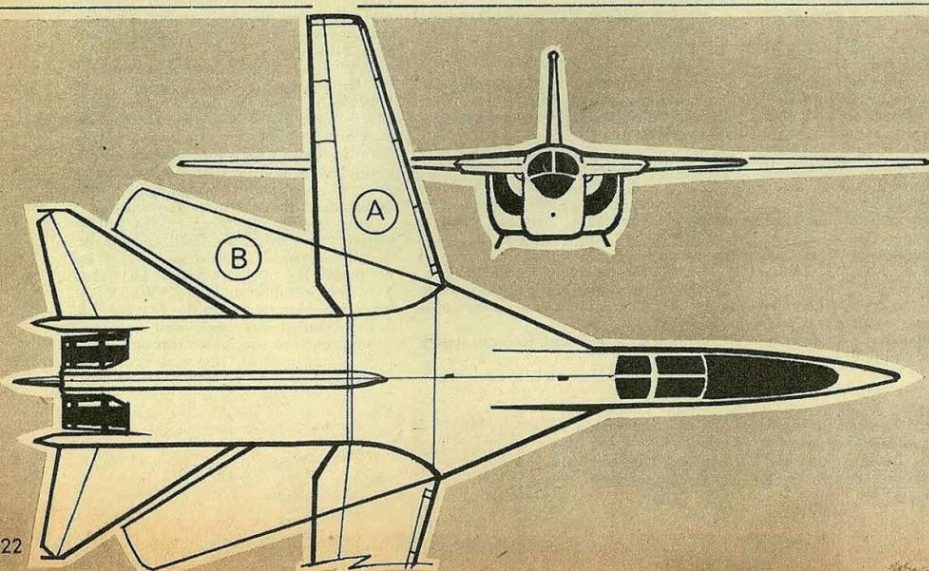
SHAPED FOR SPACE

One of the space-flight industry's toughest problems is that of the space-craft's re-entry into the earth's atmosphere. Although present-day astronauts can manoeuvre their capsules in space, and scientists calculate their exact point of re-entry and landing, once the space-craft is hurtling through the blanket of air that surrounds the earth little guidance is possible. With this in mind designers are exploring new shapes which, when applied to space-craft, will allow a far greater degree of pilot control after re-entry. Such an "aerospace vehicle" is shown here. Designed by America's National Aeronautics and Space Administration (N.A.S.A.) and now being built by the Northrop Corporation, it is designated HL-10. The craft has no wings, but aerodynamic lift is produced by the round-bellied, flat-topped fuselage, which is why this and other aerospace craft are known technically as "Lifting Body Research Vehicles." Diagram shows (A) combined elevators and ailerons and (B) rudder. The HL-10 is launched from a mother-plane, to which it is attached by fittings (C). Trim is maintained by jettisoning ballast from tanks (D) through pipes (F). The pilot (E) is well forward in the nose. Instrument and hydraulic systems (G) are fixed between retractable landing-gear (H), and air speed is recorded by boom (J).



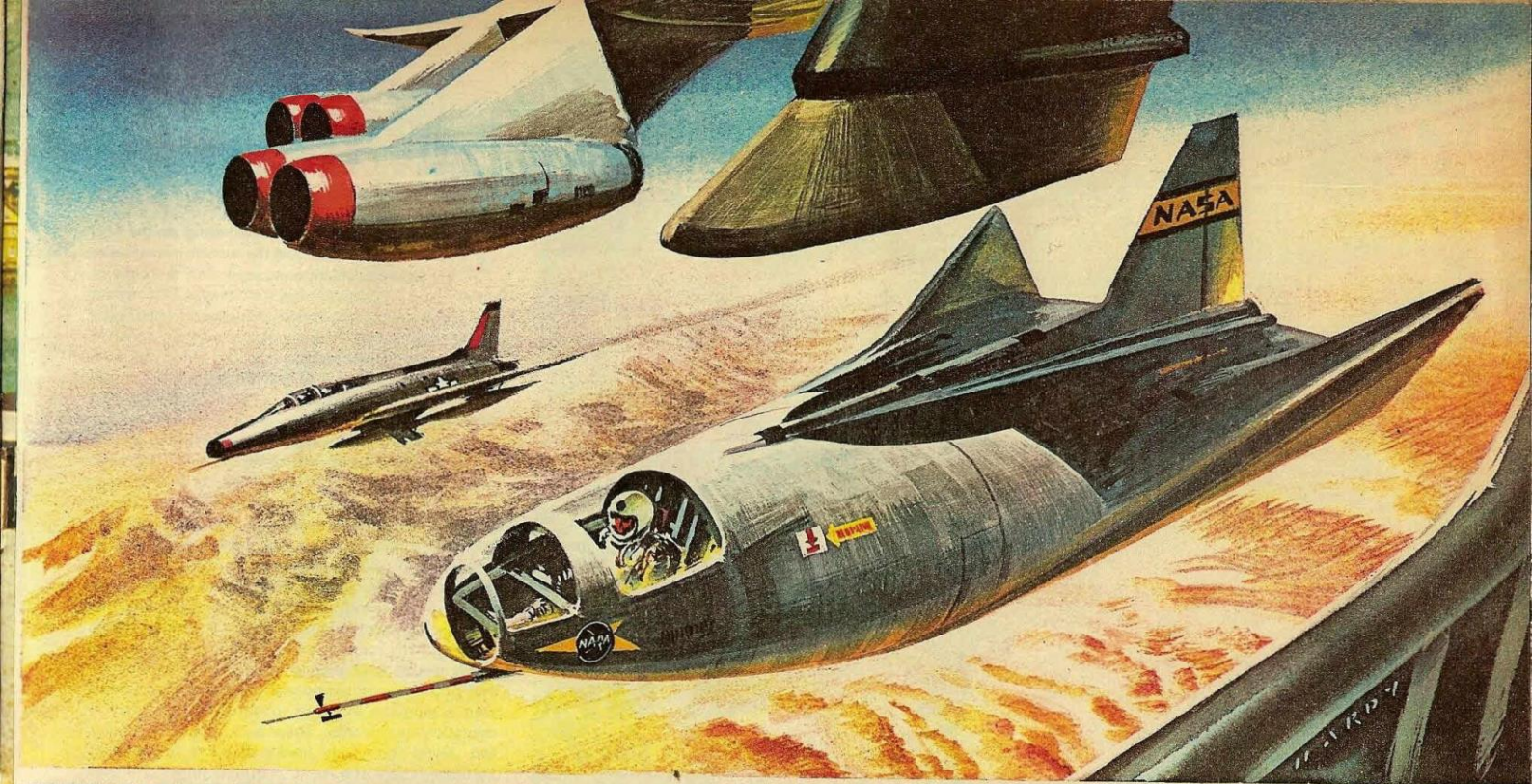
TOSS-UP FOR A COIN

The aircraft is as much a part of a modern battle as the tank or machine-gun. It provides ground support and rapid transport, acts as ambulance, observer and airborne strike force all rolled into one. An aircraft capable of carrying out many—or all—of these roles would be invaluable to a ground commander, and for this reason the United States armed forces launched a design contest for a COIN (Counter-Insurgency Aircraft) in 1963. Would-be manufacturers were told that the plane should be capable of landing and taking off in short distances on roughly-prepared runways—or no runways at all—and be able to fly on one engine at 10,000 ft. The maximum speed was to be at least 275 knots, and the COIN should be able to take off and land on an aircraft-carrier. Out of the submitted designs the U.S. Navy preferred the North American NA-300 (now known as the OV-10A) and this was announced as the winner by President Johnson in 1964. Other services were strongly in favour of the Convair Model 48 Charger, seen here. Its twin T.74 turbo-prop engines give it a top speed of 403 m.p.h., yet its design is such that it can "loiter" on station at just over 40 m.p.h. Diagrams show (A) how paratroops fit into the "utility bay," (B) is the photo-reconnaissance version and (C) the flying ambulance.



SWING-WING FIGHTER

In recent months a great deal has been heard about the respective merits of Britain's TSR-2 "manned missile" and the United States's F-111A (TFX) tactical fighter. We know now that the TSR-2 has been cancelled, despite the fact that test flights gave every indication of TSR-2 being one of the most sophisticated weapons of our time. It seems likely that the R.A.F. will now be armed with the American swing-wing F-111A, seen here. For take-off, landing and flying at low speeds the wings are moved into position A (see diagram), but once the aircraft is accelerating they are moved back until at maximum speed they are in position B, at a swept-back angle of 72.5 degrees. It is hoped that this "variable geometry" principle will allow the aircraft to operate at various heights and speeds, thus avoiding the need for building many different types of plane. The system is not yet fully proved, and it may be that unexpected snags will delay production of the F-111A and its naval counterpart, the F-111B. The two Pratt and Whitney TF30-P-1 turbofans are expected to give a maximum speed of about two-and-a-half times the speed of sound at 40,000 ft., with a maximum range of over 3,000 miles. Length: 73 ft. Wingspan (extended): 63 ft.; folded: 31 ft. 11 in.



LOOK AND LEARN

No. 184, 24th JULY 1965

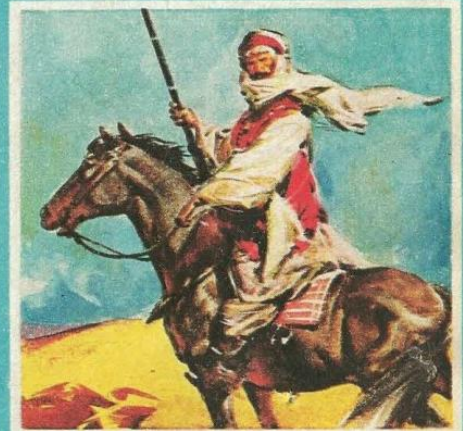
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COSTUME QUIZ

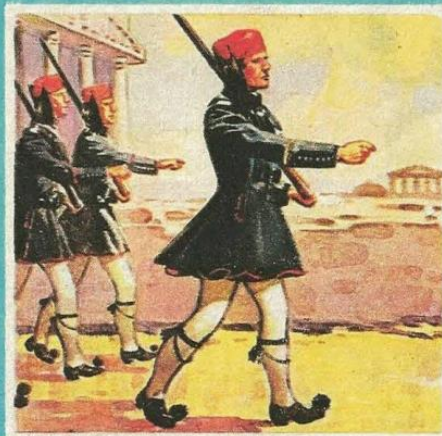
Here are seven figures in colourful national costume.
Can you identify them? Answers on page 2.



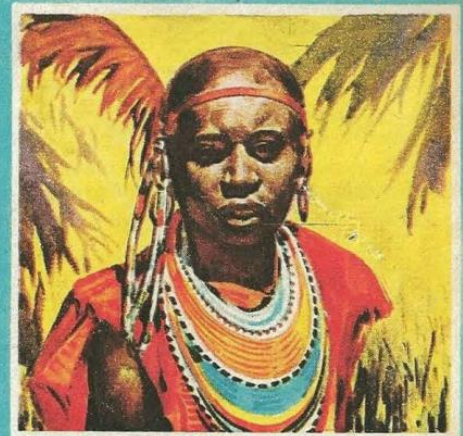
1 The girl in the colourful dress comes from the "granary" of Russia. What is the name of this region?



2 Can you say to which proud, nomadic desert people this Arab horseman belongs?



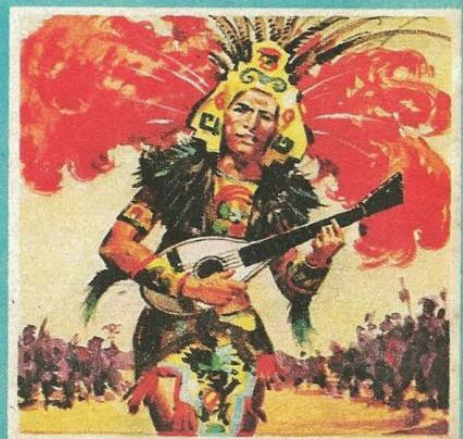
3 These kilted soldiers are a part of the Royal Guard of an ancient country. Which one?



4 Can you say to which tribe of Kenya this gaily dressed native girl belongs?



6 The home of this girl lies among mountains, snow and edelweiss. What is the name of the country?

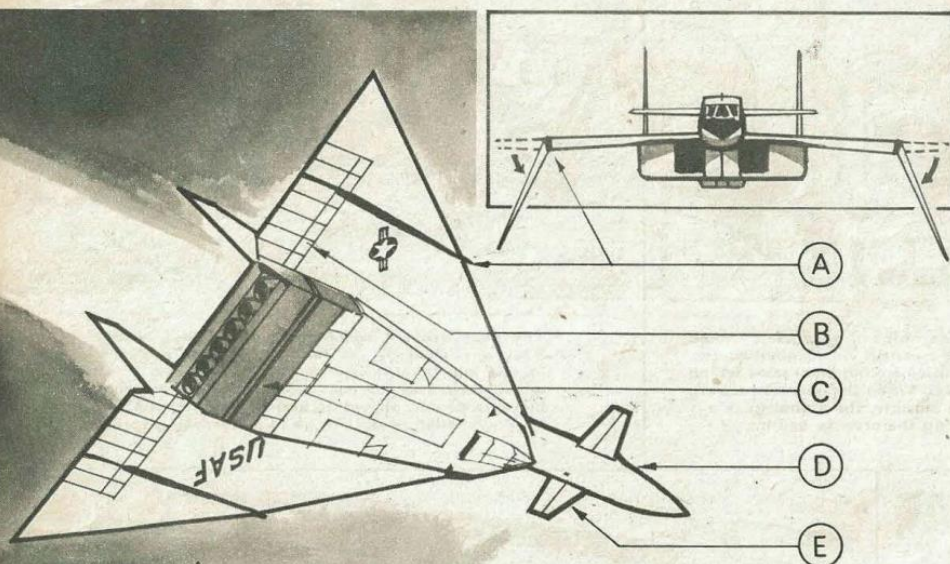


7 The ancestors of this striking dancer were conquered by the Spanish years ago. Who were they?

5 Where in the East Indies would we see a girl like this, bearing offerings of fruit and flowers?

Continuing our look at the latest developments by land, sea and air

TWO GIANTS AND A PYGMY



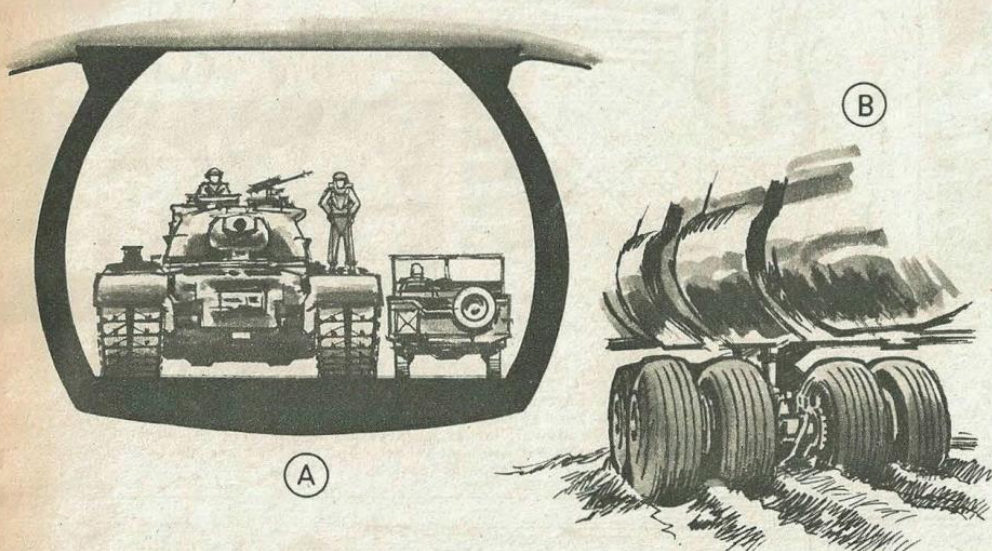
VALKYRIE—THE SUPER-BOMBER

Late in 1954 the U.S.A.'s Strategic Air Command, with its eye well on the future, put in a request to the Department of Defense for a bomber which would eventually replace the then-current B-52. Among the official requirements for the project were a range of six thousand miles, a cruising speed of just under the speed of sound, and a "dash capability"—i.e. for bursts of speed to reach a target—which was supersonic.

Ten years later, on September 21, 1964, the first prototype took to the air. Named Valkyrie it should have been the largest, fastest bomber in existence, as well as the most expensive. It embodied some of the most advanced concepts in aircraft design—and yet, even before it left the ground, it had been cancelled as a military project.

Why? The answer is simply that in terms of the cost and the effectiveness of attack weapons, the Valkyrie could not hold a candle to the new generation of ballistic missiles.

The diagram shows (A) the point at which the wing-tips fold for high-speed stability (see inset) and (B) the split control surfaces. There are six YJ93-QE-3 turbojet engines (C). At (D) the nose forward of the windshield slides up to protect it in high-speed flight. (E) is a foreplane.



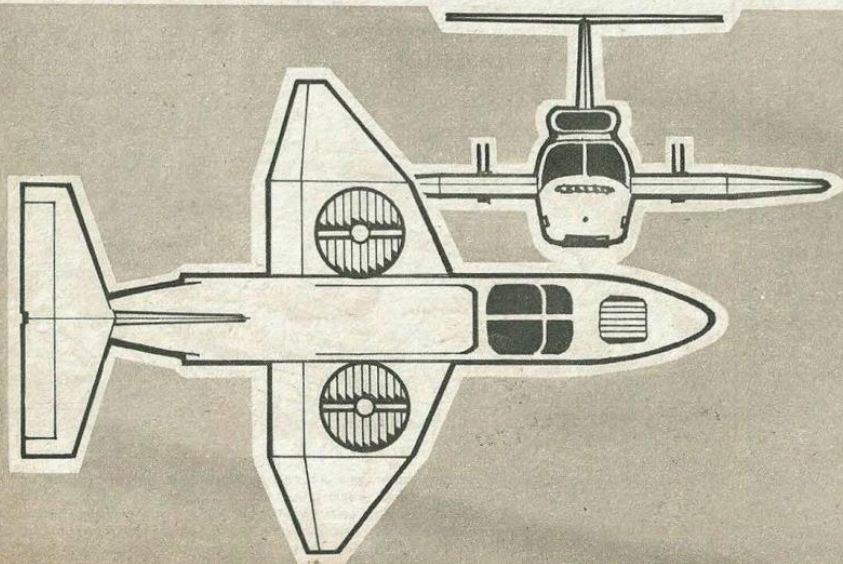
HUGE TRANSPORT FOR U.S.A.

Now news of another American giant—but one which, unlike the Valkyrie, seems destined for mass-production. This is the massive C-5A, a transport aircraft which, in its military version, will be capable of carrying a 110-ton cargo for distances up to six thousand miles.

The fuselage will be a staggering forty yards long, and as you can see here in diagram A, has enough width to accommodate tanks and jeeps side by side. There will be loading ramps at front and rear, and the whole nose section of the C-5A will swing aside in order to permit the forward ramp to be lowered.

Because of the tremendous weights it will carry, the new transport will need specially designed landing gear, particularly if it is to operate from rough or unprepared runways. Diagram B (left) shows one leg of the test undercarriage with its low-pressure tyres. It is expected that the C-5A will have a total of twenty wheels.

At present three American companies—Boeing, Douglas and Lockheed—are producing designs for the Department of Defense. Development alone is estimated to cost somewhere in the region of \$750 million, to which must be added the price of no less than fifty-eight aircraft for delivery.



FLYING WITH FANS

Vertical and Short Take-Off and Landing (V/STOL) aircraft have been featured on this page in the last two issues, and this week we show another type of "jumping jet"—the Ryan XV-5A.

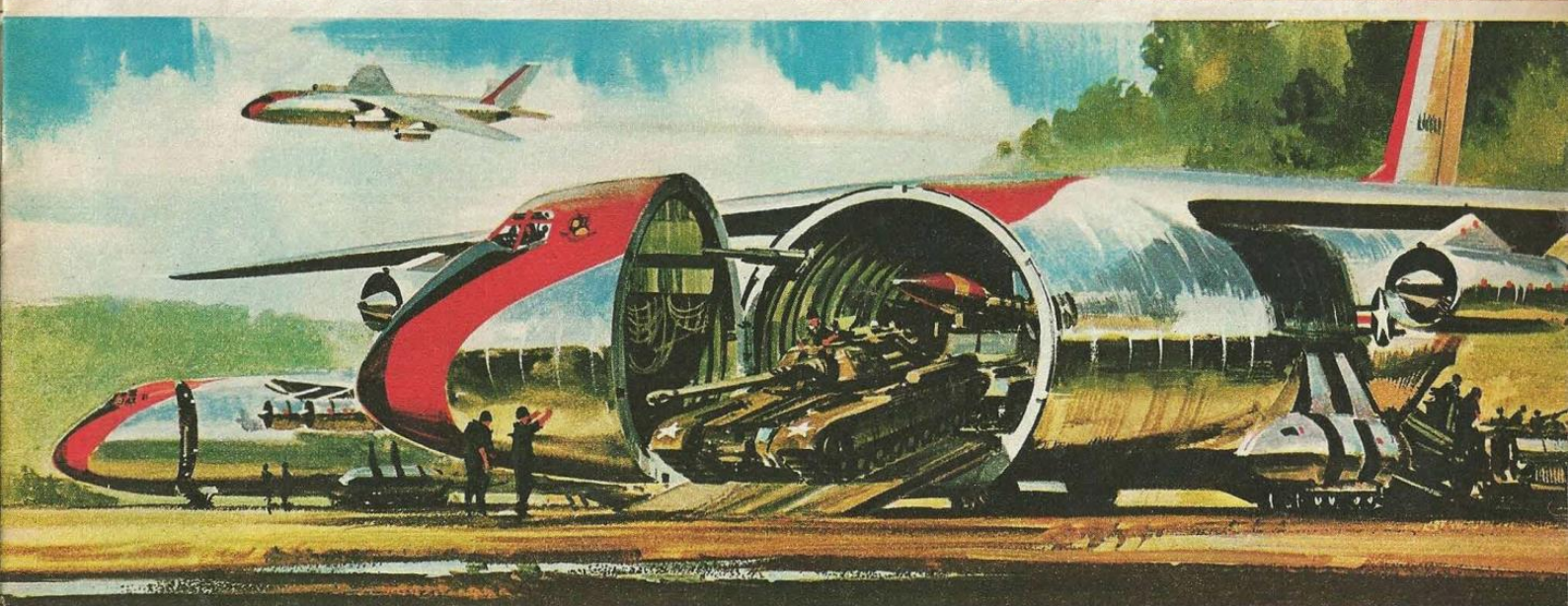
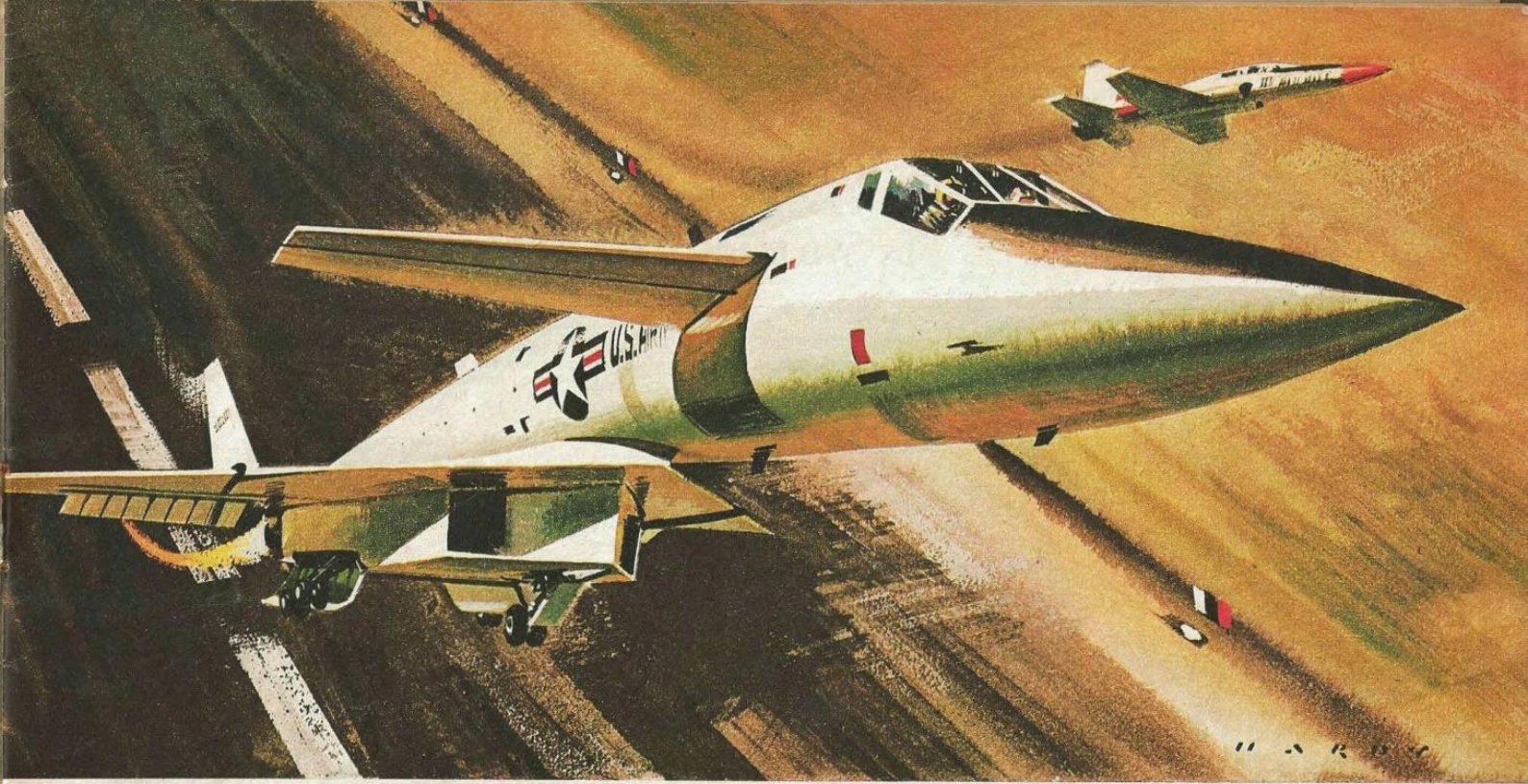
This relies for its lifting power on two contra-rotating fans set in its wings. The power to drive these is taken from two J 85 turbojets mounted side by side in the fuselage. The jet gases are diverted through ducts and on to turbine blades fitted on the fans. These revolve and carry the aircraft upwards.

For forward flight the jet exhausts are directed to the rear of the aircraft, as in a conventional aeroplane. A smaller fan in the nose is used to give added control when manoeuvring.

The exhaust gas delivery system to the fans is so arranged that should one of the jet engines fail, the other will continue to keep all three fans revolving.

The XV-5A has a maximum speed of 475 knots at sea level, and a stalling speed in conventional flight of 82 knots. (It can, of course, hover motionless if the fans are brought into action.)

Dimensions: Length, 44 ft. 6 ins.; Span: 29 ft. 10 ins.



LOOK LEARN

No. 185, 31st JULY 1965

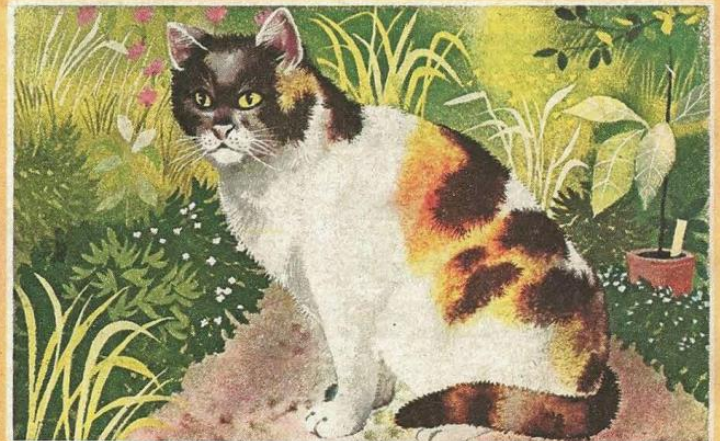
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CAT QUIZ:

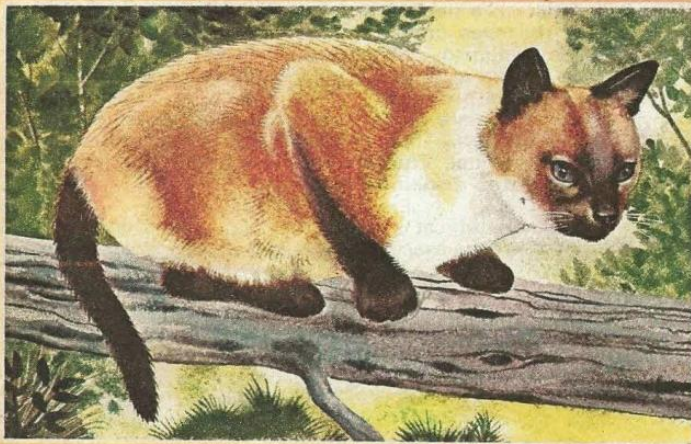
Can you identify the six cats shown here? Answers on page 2



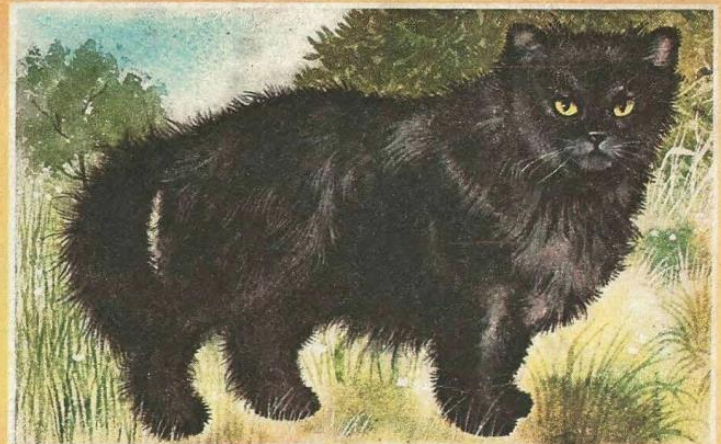
1 This well-known cat gets its name from a British island—but which one?



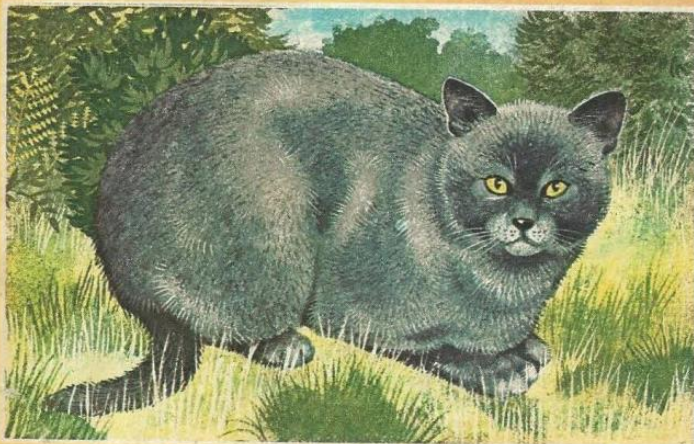
2 Can you identify this beautifully patterned cat? The colours are clear cream, black and white.



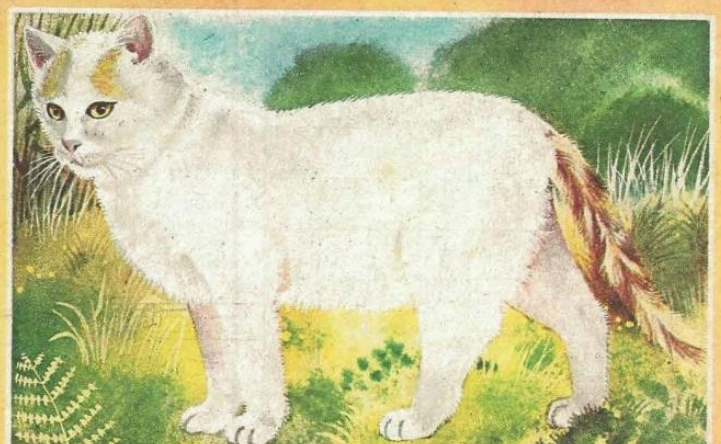
3 Of all the pedigree cats in Britain today, this is the most popular. What is it?



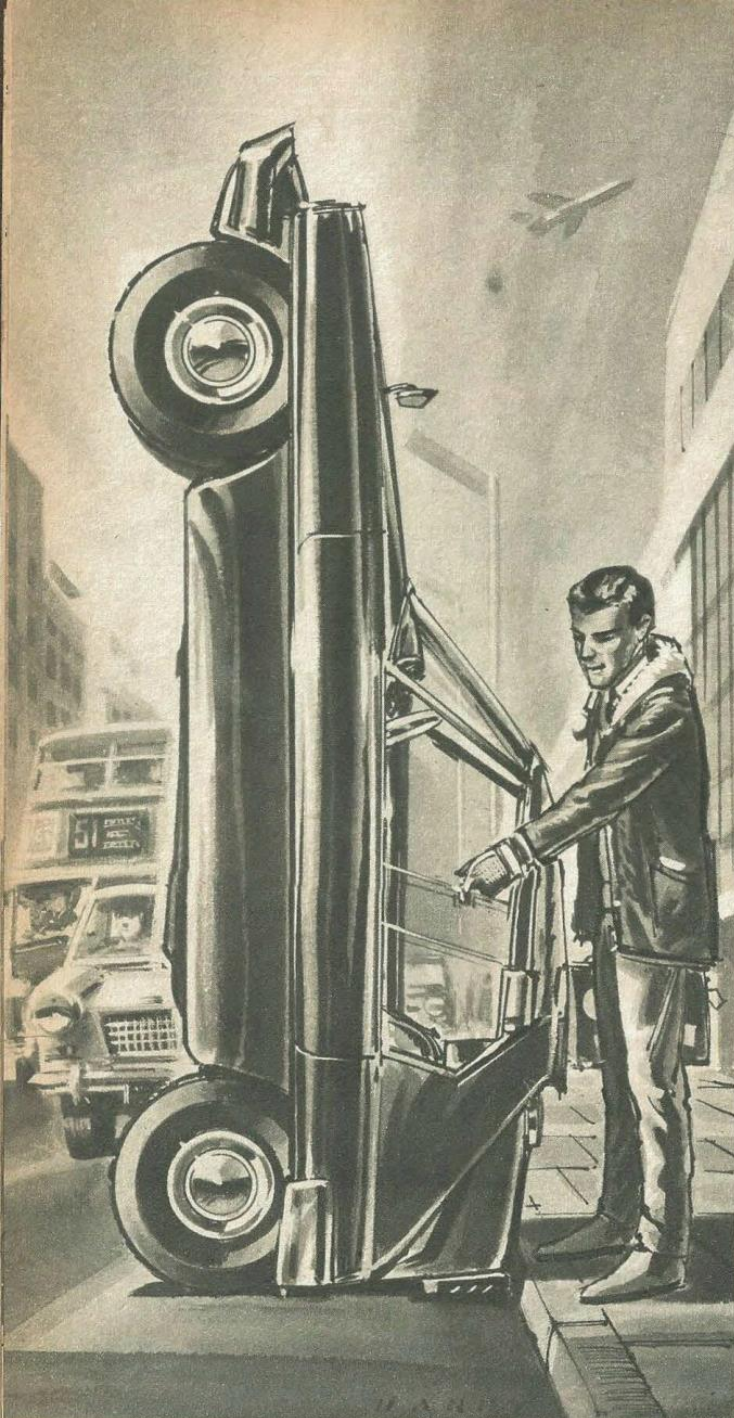
4 This cat's "ancestors" are believed to have been imported from Asia. Can you name the breed?



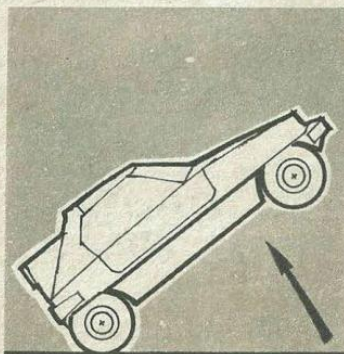
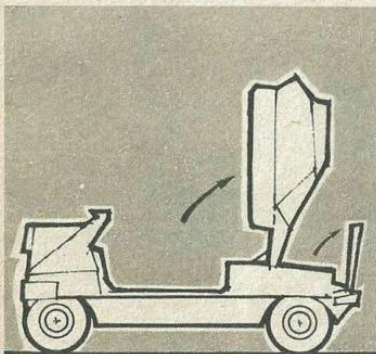
5 Typically British, this short-haired cat is always in great demand. What is its name?



6 Turkey is the home of this cat which loves to swim. Can you name it?



Firmly settled on its heel pad the car is vertically parked—and nobody can complain about the space it takes up! There is no problem in getting it on the road again, either, even if it is hemmed in by other cars. The luggage boot, being in the front, can still be reached while the car is vertically parked.



THIS
MODERN
AGE



This rear view of the car on the road shows how the whole rear has been planned to provide a good solid base for vertical parking.

CAR THAT SITS ON ITS TAIL

... Will it solve the city parking problem?

A SINGLE-SEATER car that sits on its tail at the kerb-side is the latest idea to help solve the problem of parking in the busy streets of towns and cities.

Designed by an English firm specializing in the building of sports cars, the sit-up car will be nine feet long, which is a foot shorter than a Mini.

It will be powered by a 250 cc. motor-cycle engine which will give it a top speed of over sixty miles an hour. The engine is designed to work on a mixture of oil and petrol and the car will do about fifty miles to the gallon.

The engine, petrol-tank and other heavy equipment will be mounted over the rear axle. This makes the car very light in weight so that one person can easily tip it up on its end for parking.

Instead of a rear bumper, the car will have two heavy rubber pads and a metal "heel" on which it rests while standing on end. When parked in this way, the "sit-down" car will occupy only one square yard of the roadside. If necessary, the car can be pivoted or swung round while parked.

In order to save weight so that it can be lifted easily on to its "tail," the car will be built of very light materials. The body will be of fibre-glass and the chassis made of a very light but strong kind of plywood.

The wooden chassis, which is a completely new idea in motoring, was developed from the technique used in the building of the Mosquito fighter-bomber. This was an exceptionally fast aircraft of the second World War which had a wooden fuselage and wings.

Roof, side windows and windscreen of the new car will be made in one piece and form a canopy. There will be no doors, and in order to get into or out of the car the driver will raise or lower the canopy.

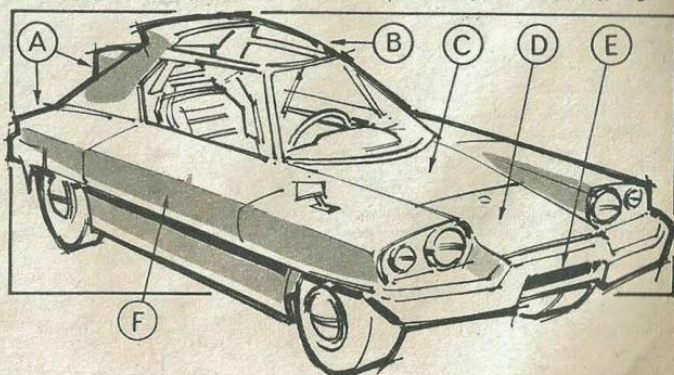
To prevent the driver from being injured in the event of the car overturning, there will be a strong steel bar running the length of the roof. If the car does overturn, the bar and the shape of the roof will help it to right itself again.

The "sit-down" car is not just a glorified bubble car. It will be much more strongly built and more comfortable to drive and to ride in.

Although the engine will be at the rear, there will be a sloping bonnet at the front which will act as the cover of a boot for storing luggage. This boot can be opened or shut whether the car is standing on its four wheels or sitting parked on its tail.

The designers of the "sit-down" car hope to have the first ones built and on the road by the end of the year.

The drawings below show what happens on arrival. The cockpit cover lifts and still gives access to boot. The mass weight over the rear makes for easy lifting. Parts of the car are (A) cast alloy heel pad and hard rubber inserts; (B) tinted top panel; (C) steering column and instruments which lift with cockpit cover; (D) luggage boot; (E) recess for lifting; (F) fibreglass body. The fuel tank is designed to avoid spillage.



LOOK AND LEARN

No. 400, 13th SEPTEMBER, 1969



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RANGER

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EAGLE'S LAIR

A true story of four men's terrible ordeal in the Maritime Alps
(See pages 10-11)



LOOKING INTO SCIENCE

TRACKED HOVERTRAINS

MODERN trains speeding at around 100 mph may have a new and faster rival in a few years. This will be a unique adaptation of the hovercraft, invented by Christopher Cockerell in 1953 and described in this feature last week.

But the new train will be without wheels or conventional rails and its speed should be up to 300 mph.

It will be supported and guided by air cushions made by jets of the type designed by Cockerell. The propulsion is by linear induction motor. In this case a magnetic force is set up between the rail, which serves as a fixed rotor (like the rotor in an ordinary electric motor) and the stator which is in the train's motor. But there is no contact between the rail and the motor.

Also, as there is no contact between the train and its track, there is no friction to impede the high speeds which are possible.

A company called Tracked Hovercraft Ltd. has taken over the job of promoting the world-wide use of high-speed guided land hovercraft transport systems.

Static rig and small-scale working models were tested. Then the time came to test and demonstrate a full-scale vehicle. Eventually a site running between two drainage rivers near the Wash was chosen.

The new vehicle will be used for both

tests and demonstrations. Much of the space in it will be taken up by test equipment. But, in addition to a crew of two, there should be room for three or four rows of passenger seats, each row containing four seats divided by a centre aisle. The vehicle will be about 50 ft. long and 10 ft. wide and it will weigh some 10 tons. The experts expect that it will be running on a few miles of track by early 1970. The track itself will be in the form of a T-section reinforced concrete beam about 7 ft. wide and 4 ft. deep.

Hoverbed

A similar vehicle will be tested in America. There, the General Electric Company has been asked by the U.S. Government to make a Tracked Air Cushion Research Vehicle which will "fly" at about 3 ft. above and between a fixed guideway. The Americans say that their vehicle could be in public use by 1975. It could, they say, provide faster inter-city transport.

The history of the hovercraft would not be complete without an account of an interesting medical use.

In June, 1967, it was announced in an article in the medical journal, *The Lancet*, that the first two badly burned patients had been successfully treated on a

hoverbed. One was on the hoverbed for six hours and the other for 15 1/2 hours. In both cases, the doctors reported improvements in their patients' conditions.

On the hoverbed, the patient is left solely supported on air, though normally the head rests on a pillow.

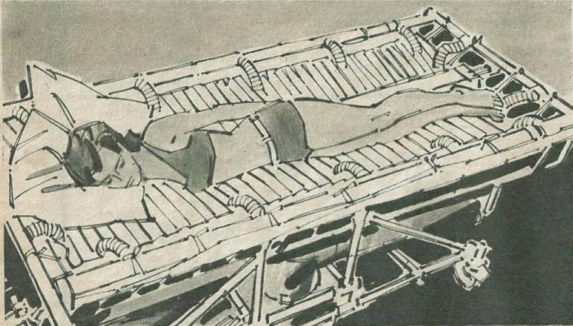
The air supply is housed in a four-wheeled trailer outside the ward. After the treatment is ended, the fabric of the hoverbed can be removed, suitably wrapped and sterilised.

The first industrial use of the hovercraft principle to make a mark was air-cushioned load removal, for which a heavy load transporter was made.

Perhaps the most spectacular industrial use was the moving of two oil-storage tanks 200 yards to a new site.

Special skirts were strapped around the base of the tanks. Air pumped in at only 60 lb. per square ft. raised each tank 7 inches off the ground. Each could then be winched slowly and carefully along its route.

The principle on which the hover trains on the right are propelled is that of the electric motor. But instead of a rotating armature (or rotor), the rotor (which is a single railway line) is fixed. Consequently, magnetic forces propel the train.

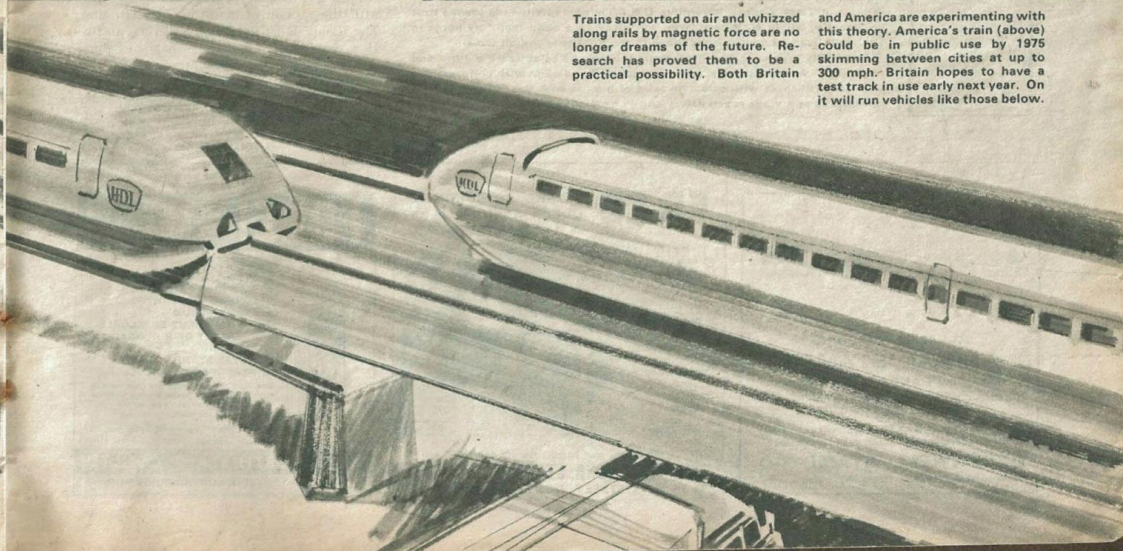


Hoverbeds (above) were designed for the treatment of badly burned patients. When the patient is placed on the bed, pockets form a seal along the side of his body and fall away beneath it so that the body is left solely supported on air. Right: Air pumped in at only 60 lb. per square foot raised this storage tank 7 inches off the ground so that it could be carefully winched to a new position.



Trains supported on air and whizzed along rails by magnetic force are no longer dreams of the future. Research has proved them to be a practical possibility. Both Britain

and America are experimenting with this theory. America's train (above) could be in public use by 1975 skimming between cities at up to 300 mph. Britain hopes to have a test track in use early next year. On it will run vehicles like those below.



LOOK LEARN

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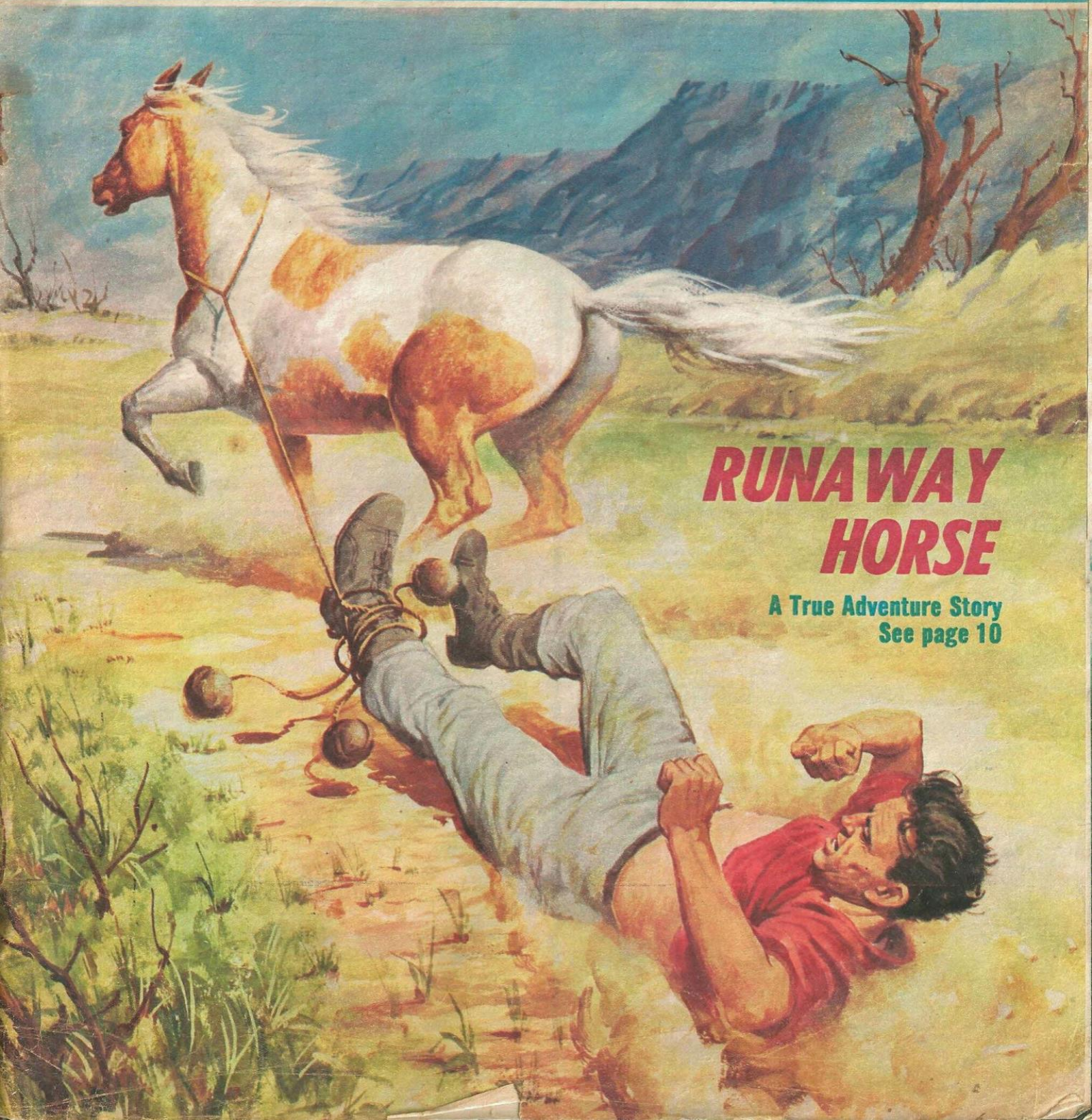
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RUNAWAY HORSE

A True Adventure Story
See page 10



American, Dan Taylor, at the conning tower of the little yellow submarine he is using in his search for the Loch Ness monster.

MONSTER HUNT

THE Loch Ness monster has been the subject of countless tales and legends. Is there really a monster in the lake? Or are the reports of the heads, tails and humps seen in the loch pure imagination?

Millions of years ago, Loch Ness was an inlet of the sea. Then the land rose and the loch became an inland lake. The sea creatures trapped in the loch were forced to remain there and breed.

Crofters of the Scottish Highlands passed stories on to their children about the great beasts that lived in the lochs. Loch Ness itself could certainly contain several monsters. It is 24 miles long, over a mile wide and 754 ft. deep.

"Nessie," as she is known locally, was first seen according to most reports, in 1933. A motorist driving along the shores of Loch Ness, saw in the distance "a strange object." It was 30 ft.

long with two humps and a snake-like head at the end of a long neck, and two flippers.

Even earlier, in 1930, some children told their teacher of a large and horrifying monster they had seen in the loch. When asked what the monster was like,

they pointed to a picture hanging on the wall of a plesiosaurus, a prehistoric animal.

Opinions conflict on almost everything to do with the Loch Ness monster. People who claim to have seen Nessie include four ministers, two doctors, a surgeon, M.P. and a vet. A whole tourist industry has been built up in Scotland around the creature.

Tim Dinsdale, a 42-year-old ex-aeronautical engineer obtained film in 1960 of what seemed to be a large creature swimming in the loch. Although the film has been shown all around the world, it does not present conclusive evidence that the monster really exists.

In 1968, a team of scientists from Birmingham University recorded something "startling" with their sonic cameras. White blobs appeared on a black screen of two big fast-moving objects in the waters.

Now, at last, a tiny yellow submarine may finally solve the mystery of the Loch. Dan Taylor, a submarine expert from America, is at present systematically

searching the dark waters for Nessie. 28-year-old Dan built his own submarine, at a cost of £8,300. The yellow craft is 20 ft. long, 5 ft. wide and weighs two tons, and it is made from 600 layers of steel reinforced fibreglass.

The survey is being organised by the Loch Ness Phenomena Investigation Bureau set up in 1962. The Bureau watches for Nessie from May to October when six cine cameras are trained on the loch.

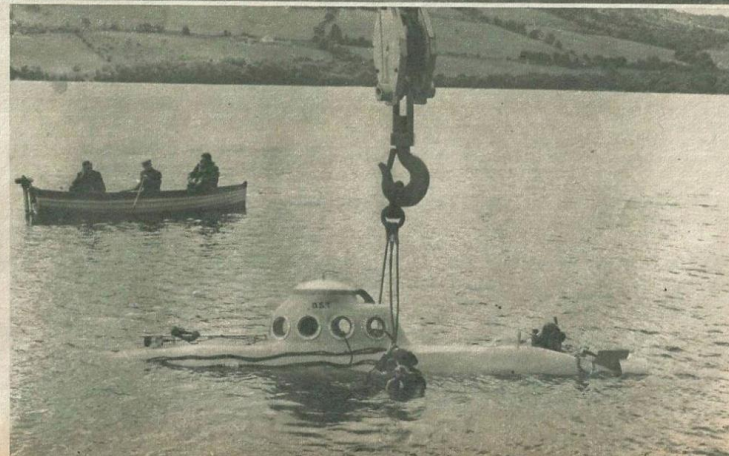
Strong lights will help Dan to see clearly if he and the monster come face to face. The American is also using a biopsy dart to take a sample of the creature's skin, if it appears. This will then be analysed in a laboratory.

This project could very well produce the first material proof of the existence of the Loch Ness monster.

Lowering the submarine into the waters of Loch Ness which are 700 ft. deep, before starting to look for the monster.



The submarine, which Dan Taylor built himself, on its way to the loch by road, to make its first investigation dive.



LOOK LEARN 40 PAGES

No. 405, 18th OCTOBER, 1969

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**CARD
INDEX OF
KNOWLEDGE**

***Britain's
Newest
Record
Breaker!***

See page 8



**LOOKING
INTO
SCIENCE**



A-P-T SPELLS SPEED!

Railways have been bringing out better trains for 140 years. Now they are trying to improve them even more in order to draw passengers away from air travel. In fact a new train being planned will be faster, smoother, quieter and safer than those of today.

Since 1966, British Rail have been developing an Advanced Passenger Train—called A.P.T. for short—which is really quite new.

At first glance, it looks like any other modern, streamlined passenger train of the type that has no separate engine on the front but uses either electric traction or diesel engines under the coaches.

But it weighs about half as much as today's trains of the same seating capacity, because it is made more like an airliner.

Its engines, too, are like those of an airliner, for they are gas turbines that are far smaller and lighter than diesel engines of the same power.

Together, these advantages will enable the A.P.T. to shoot along ordinary rails at from 150 to 200 miles an hour.

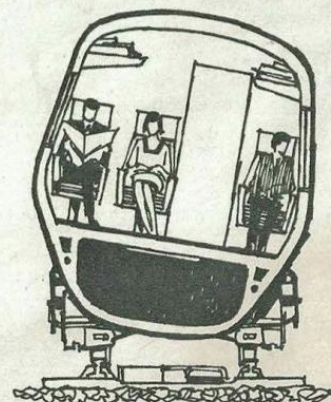
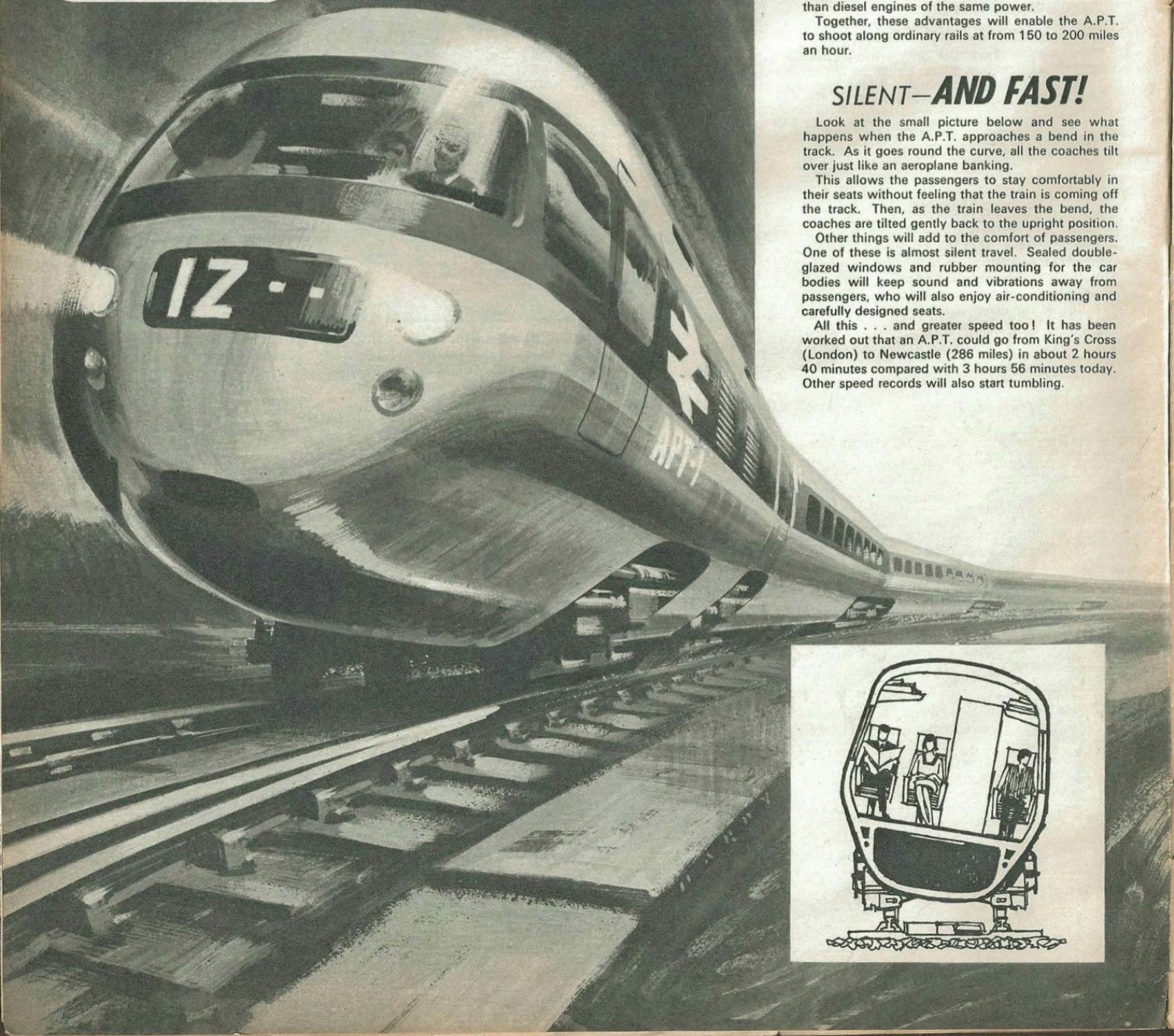
SILENT—AND FAST!

Look at the small picture below and see what happens when the A.P.T. approaches a bend in the track. As it goes round the curve, all the coaches tilt over just like an aeroplane banking.

This allows the passengers to stay comfortably in their seats without feeling that the train is coming off the track. Then, as the train leaves the bend, the coaches are tilted gently back to the upright position.

Other things will add to the comfort of passengers. One of these is almost silent travel. Sealed double-glazed windows and rubber mounting for the car bodies will keep sound and vibrations away from passengers, who will also enjoy air-conditioning and carefully designed seats.

All this . . . and greater speed too! It has been worked out that an A.P.T. could go from King's Cross (London) to Newcastle (286 miles) in about 2 hours 40 minutes compared with 3 hours 56 minutes today. Other speed records will also start tumbling.





Railway signalling and other control systems in use today will not be fast enough to cope with A.P.T.s skimming along at 150-200 mph. To overcome this, British Rail scientists are developing new methods of control. Computers and other electronic devices will be used in systems which it is hoped will be reliable and relatively cheap to install.

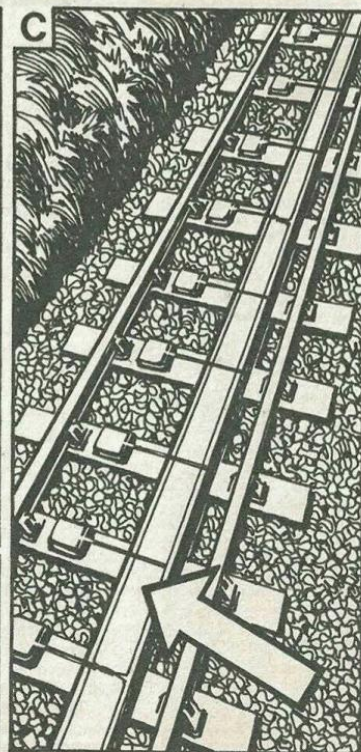
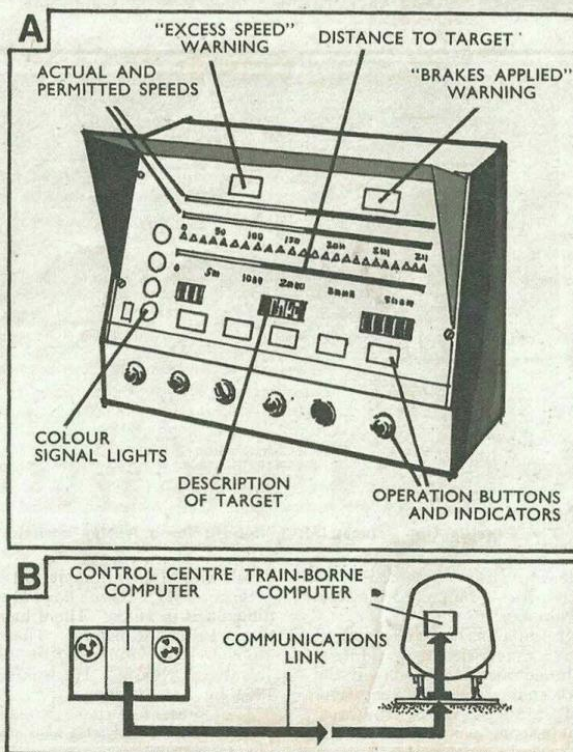
Each train will be fitted with a computer working in conjunction with other computers at the regional centres. These will keep the pattern of fast-moving traffic on the network of lines operating efficiently.

The driver of a 150 mph train must have all the signalling, speed and distance information he needs displayed before him inside his cab. This will be on a display unit like the experimental one being tested above.

Illustration A details some of the information it gives to the driver. The "target" referred to may be, for instance, a stretch of track where speed is restricted. B shows the link-up system between the train and the control centre computer which regulates speed and keeps busy junctions and stations working well. The job of the computer on the train is to show the fastest safe speed and to put on the emergency brake if the train goes too fast.

Illustration C shows a section of the railway track (arrowed) with the conductor wire system laid between the rails which relays signalling and control information to the moving trains.

This development could make Britain's trains among the world's fastest and safest.



LOOK AND LEARN 40 PAGES

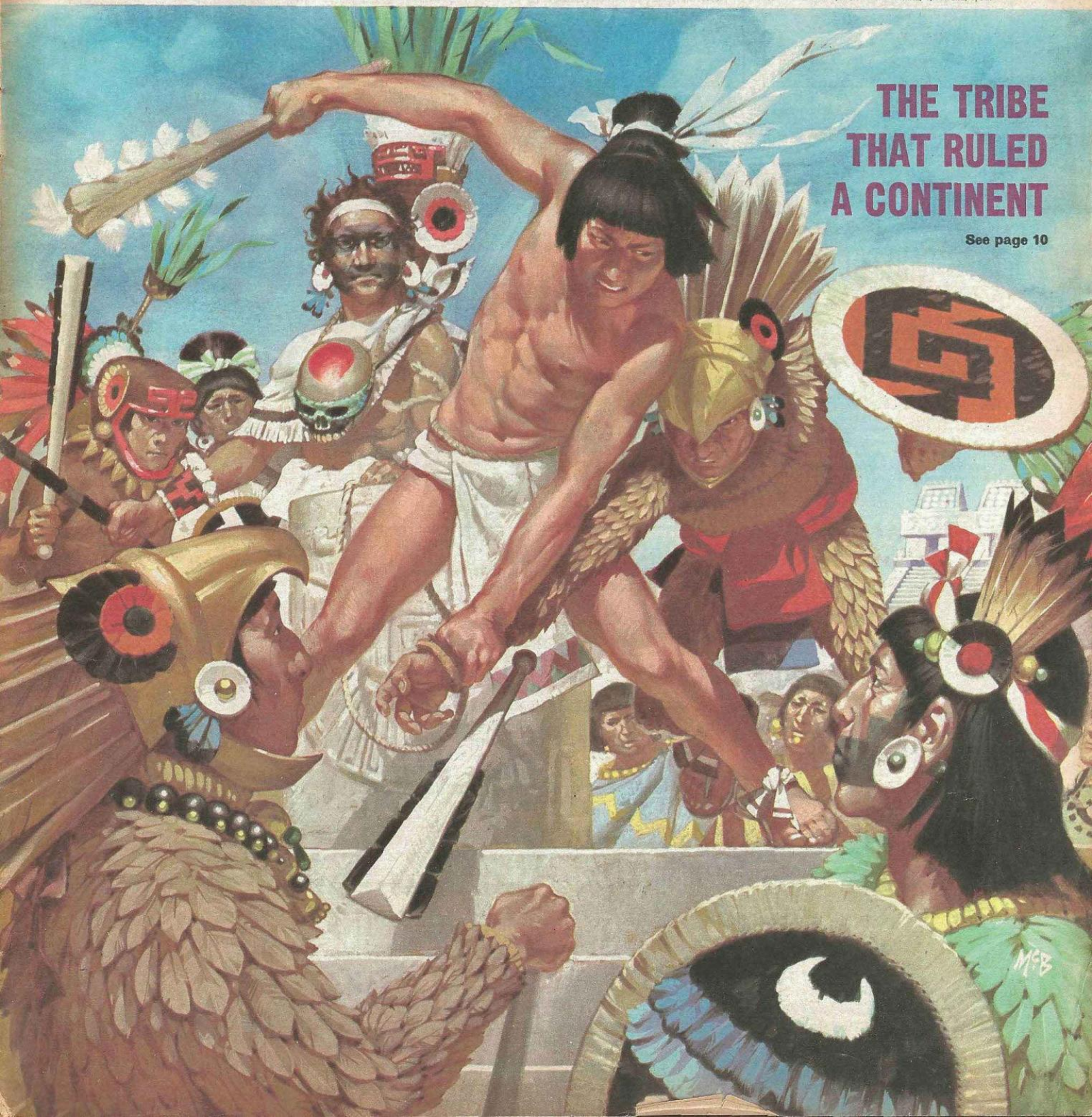
No. 408, 8th NOVEMBER, 1969

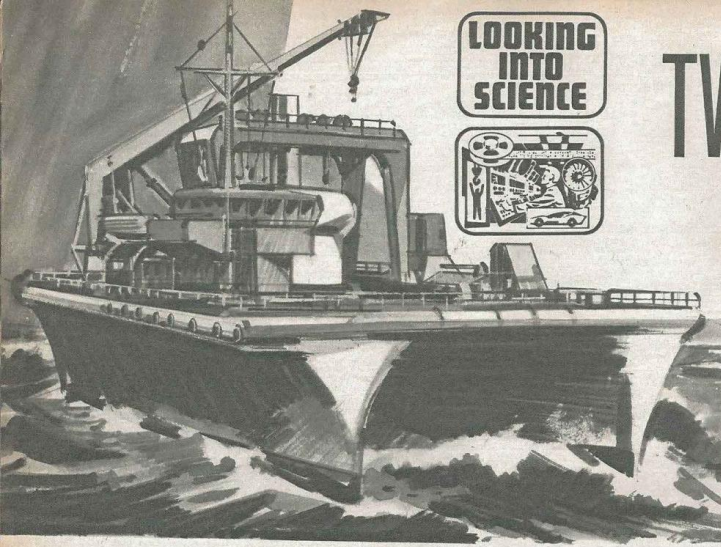
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THE TRIBE THAT RULED A CONTINENT

See page 10

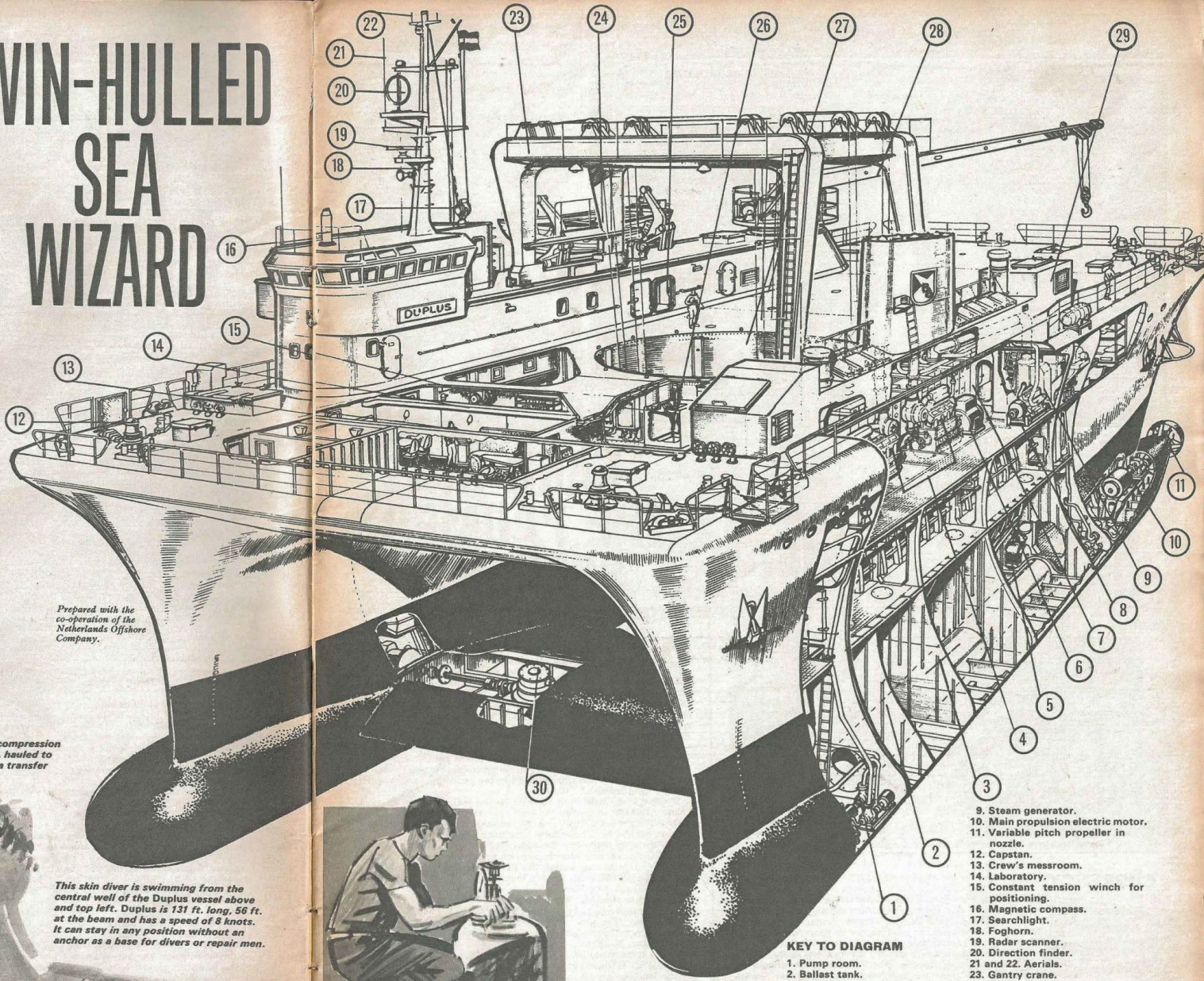




LOOKING
INTO
SCIENCE



TWIN-HULLED SEA WIZARD



Prepared with the
co-operation of the
Netherlands Offshore
Company.

A HUGE vessel which stays in one place without an anchor and scarcely heaves in the most turbulent of seas is now being used as a base for divers and repair experts.

Because its two hulls, seen clearly in the cut-away drawing on the right, are below the surface waves, the vessel—known as *Duplus*—rides the sea as smoothly as a submarine. Across the hulls is a broad, flat deck, the underside of which is above all but the most mountainous of waves.

The Dutch company which perfected this vessel have added many other assets. Among these is its ability to hold its position by means of propellers driven by electric motors and controlled by a computer. This notices the slightest movement and switches on the propeller needed to correct it. Hydrofoils link the hulls fore and aft and considerably reduce any tendency to heave and pitch, in addition to housing the positioning propellers.

Oil and gas rigs can be fixed or repaired by divers working from *Duplus*. A central well 23 ft. across is large enough for a complete diving bell to be lowered into the sea. Skin divers operating from the vessel can lay underwater pipelines or repair damaged rigs or ships.

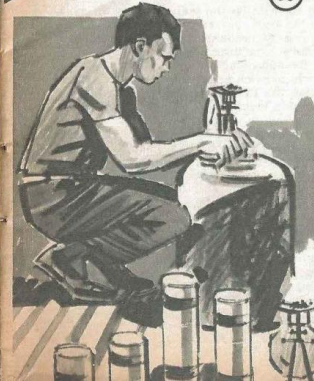
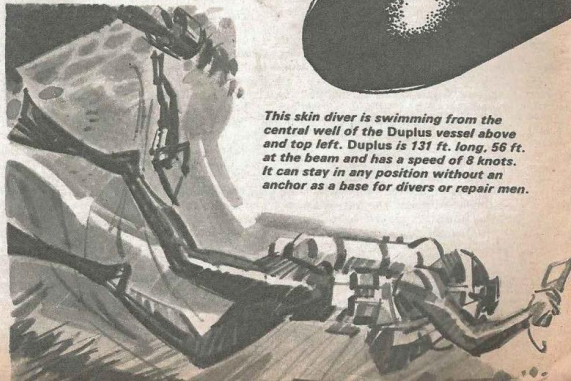
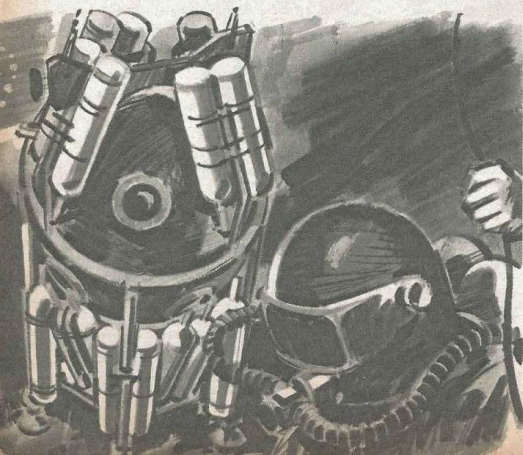
Electronic equipment is provided for sonar profiling—the mapping of the ocean bed by the use of sound waves. Samples of the sea bed can be taken with other apparatus.

Divers returning from the sea depths must become accustomed in slow stages to the reduced pressure on the surface. A new compression chamber helps this to be done efficiently.

The diver is brought to the surface in the chamber, from which he has been operating at the end of a 65 ft. air line. The diving chamber is then attached to a transfer chamber in which the air pressure is slowly reduced to a safe level.

Left: A diver returns to his compression chamber. This will be sealed, hauled to the surface and attached to a transfer chamber for decompression.

This skin diver is swimming from the central well of the Duplus vessel above and top left. Duplus is 131 ft. long, 56 ft. at the beam and has a speed of 8 knots. It can stay in any position without an anchor as a base for divers or repair men.



On board *Duplus* is a small laboratory where samples from the sea-bed can be weighed and checked (left). The vessel is stable enough for this to be done in most weather conditions.

KEY TO DIAGRAM

1. Pump room.
2. Ballast tank.
3. Fuel oil tanks.
4. Main engines.
5. Electric motor for positioning-propeller.
6. Main generator.
7. Switchboard.
8. Auxiliary diesel generator.
9. Steam generator.
10. Main propulsion electric motor.
11. Variable pitch propeller in nozzle.
12. Capstan.
13. Crew's messroom.
14. Laboratory.
15. Constant tension winch for positioning.
16. Magnetic compass.
17. Searchlight.
18. Foghorn.
19. Radar scanner.
20. Direction finder.
- 21 and 22. Aerials.
23. Gantry crane.
24. Lifeboat.
25. Diving centre.
26. Inclinator for positioning.
27. Central well.
28. Revolving crane.
29. Main winch.
30. Propeller.

LOOK AND LEARN 40 PAGES

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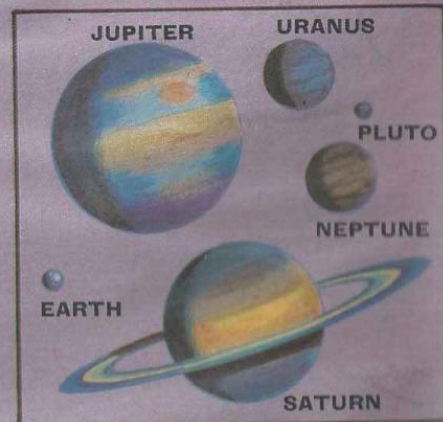
THE FIRST TOUR OF SPACE

SEE PAGE 4



FIRST TOUR OF SPACE

Written and illustrated by Will Hardy



The planets of the Grand Tour are drawn here to the same scale. The mass of the giant Jupiter is more than 300 times that of Earth. The mass of Saturn is 95 times greater.

Many exciting "side-excursions" have been worked out. For instance, if a probe were shot off just before the main craft reached Jupiter, that mighty planet's gravitational field would bend the flight of the probe into a huge U-shaped return orbit so that it would meet and pass the famous Halley's Comet as it passes through the asteroid belt in 1985.

Another possibility would be to use the "ricochet" effect of the gravity of Jupiter and Saturn to include the planet Pluto in the Grand Tour—something which would not be possible again for 500 years! The two planets would hurl the main probe on towards Uranus and Neptune while the Pluto probe would fly on a separate course, taking nine years to reach Pluto. Alternatively, a direct flight from Earth aimed at Pluto would take 41 years.

Probes might also be sent to examine the moons of the four Grand Tour planets. One of Saturn's satellites, for instance, is known to have an atmosphere and might make exciting investigating. But, perhaps most exciting of all, a probe might swing down to investigate and automatically analyse the most beautiful jewels of the solar system—the multi-coloured rings of Saturn.

Whatever the final shape and scope of the Grand Tour, it seems certain that the long flight will be one of the most exciting voyages that man's scientific curiosity has ever launched.

As men continue to explore the Moon, space scientists and engineers set their sights far beyond, preparing for the ...

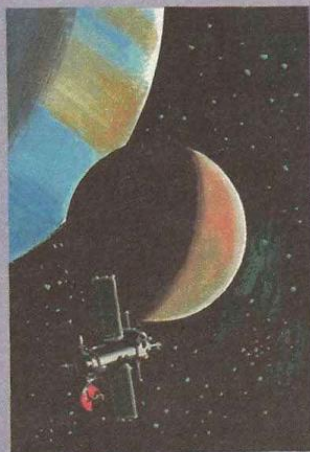
IN the 18th century, the Grand Tour meant a leisurely journey around the glittering capitals of Europe by wealthy young gentlemen. To modern space scientists it means a project which will dwarf every space achievement yet made.

The purpose of the mission is to take a huge unmanned space probe in a series of swings past Jupiter, Saturn, Uranus and Neptune. And though the last of these planets is three billion miles from Earth, the spacecraft will not be powered by any rocket or atomic engines. Once boosted on its way from Earth, it will use only the tremendous power of each planet's gravitational field to propel it. It will approach in such a way that it is first drawn in towards each planet for its investigation and then catapulted on its way to the next.

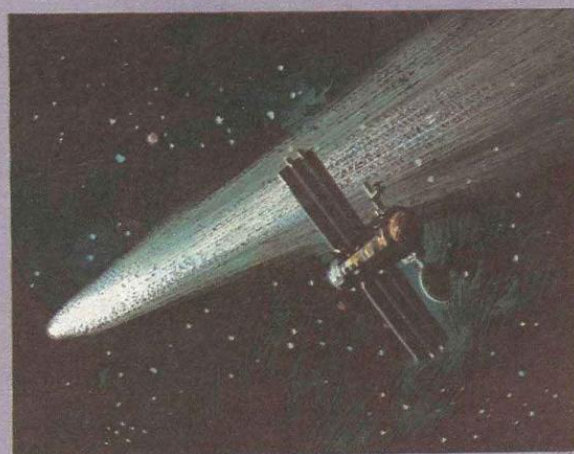
Only between 1977 and 1979 will the unique conditions occur for this mammoth hitch-hike. At this time the four planets will be in the proper alignment, after which they will gradually drift out of position in their orbits. The opportunity will not occur again for 179 years because of the very slow movement of the outer planets around the Sun.

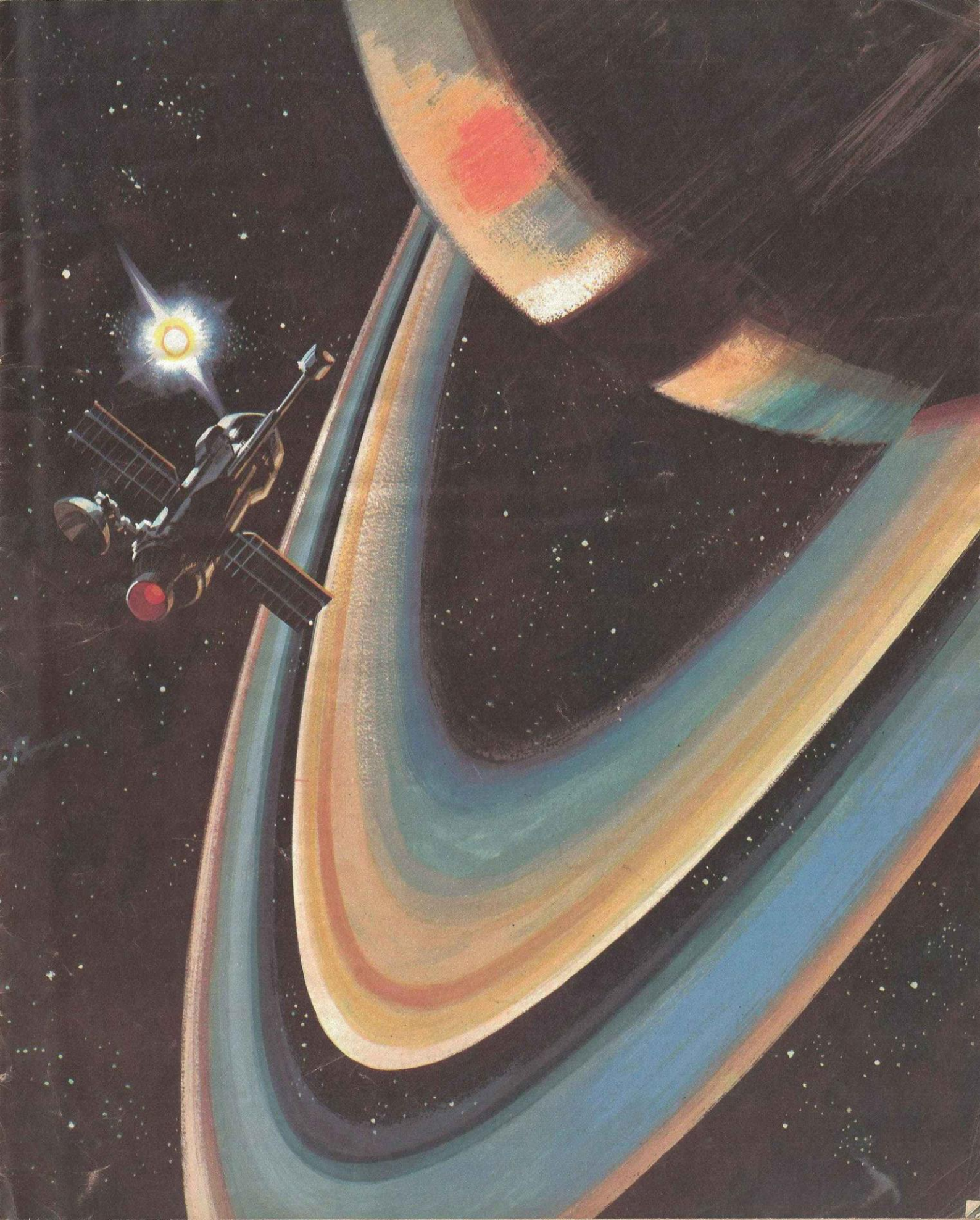
Needless to say, a great deal of scientific attention has been focused on such a unique opportunity as one of the major follow-ups to the Apollo programme.

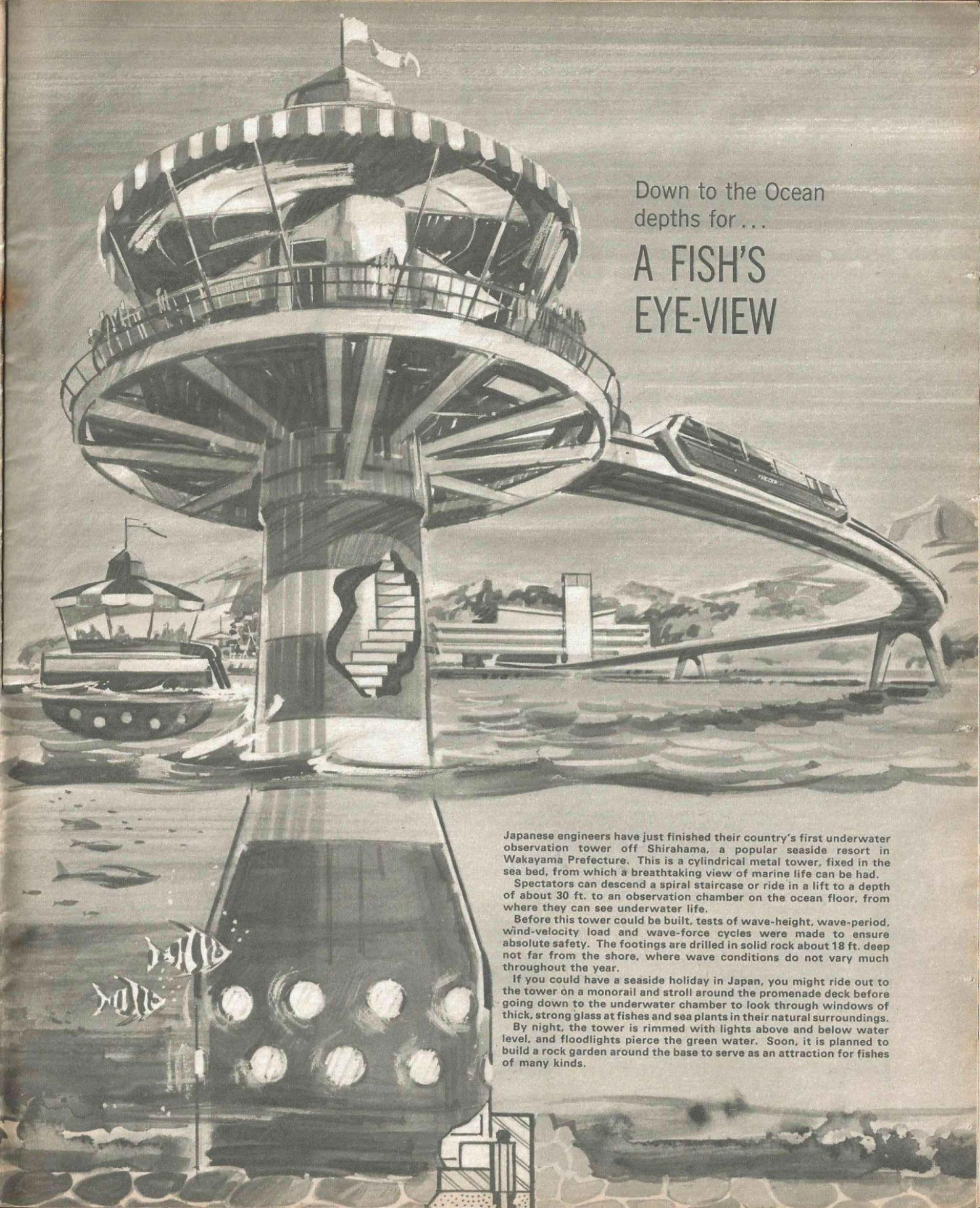
Many scientists would like to broaden the aims of the Grand Tour and turn it into a powered mission, in which small probes would be launched from the main vehicle on exciting "side-trips" of their own. Although this would be considerably more expensive than a simple drifting "fly-past," the scientists claim that our knowledge of the solar system would be increased vastly. They say that the main "mother ship" would not only gather information itself but would also act as a powerful relay station for boosting back signals from its small "messengers" to the waiting scientists on Earth.



Left: A probe launched from the main Grand Tour vehicle approaches one of Saturn's four moons, each of which is only slightly larger than the planet Mercury. The information gained would be invaluable, especially as future manned flights may land on Jupiter's satellites. Right: A probe thrown into a return orbit by the influence of Jupiter might close in on Halley's Comet as it passes through the asteroid belt. The ghostly comet approaches the sun only four times in three centuries.







Down to the Ocean
depths for...

A FISH'S EYE-VIEW

Japanese engineers have just finished their country's first underwater observation tower off Shirahama, a popular seaside resort in Wakayama Prefecture. This is a cylindrical metal tower, fixed in the sea bed, from which a breathtaking view of marine life can be had.

Spectators can descend a spiral staircase or ride in a lift to a depth of about 30 ft. to an observation chamber on the ocean floor, from where they can see underwater life.

Before this tower could be built, tests of wave-height, wave-period, wind-velocity load and wave-force cycles were made to ensure absolute safety. The footings are drilled in solid rock about 18 ft. deep not far from the shore, where wave conditions do not vary much throughout the year.

If you could have a seaside holiday in Japan, you might ride out to the tower on a monorail and stroll around the promenade deck before going down to the underwater chamber to look through windows of thick, strong glass at fishes and sea plants in their natural surroundings.

By night, the tower is rimmed with lights above and below water level, and floodlights pierce the green water. Soon, it is planned to build a rock garden around the base to serve as an attraction for fishes of many kinds.

LOOK LEARN **40 PAGES**

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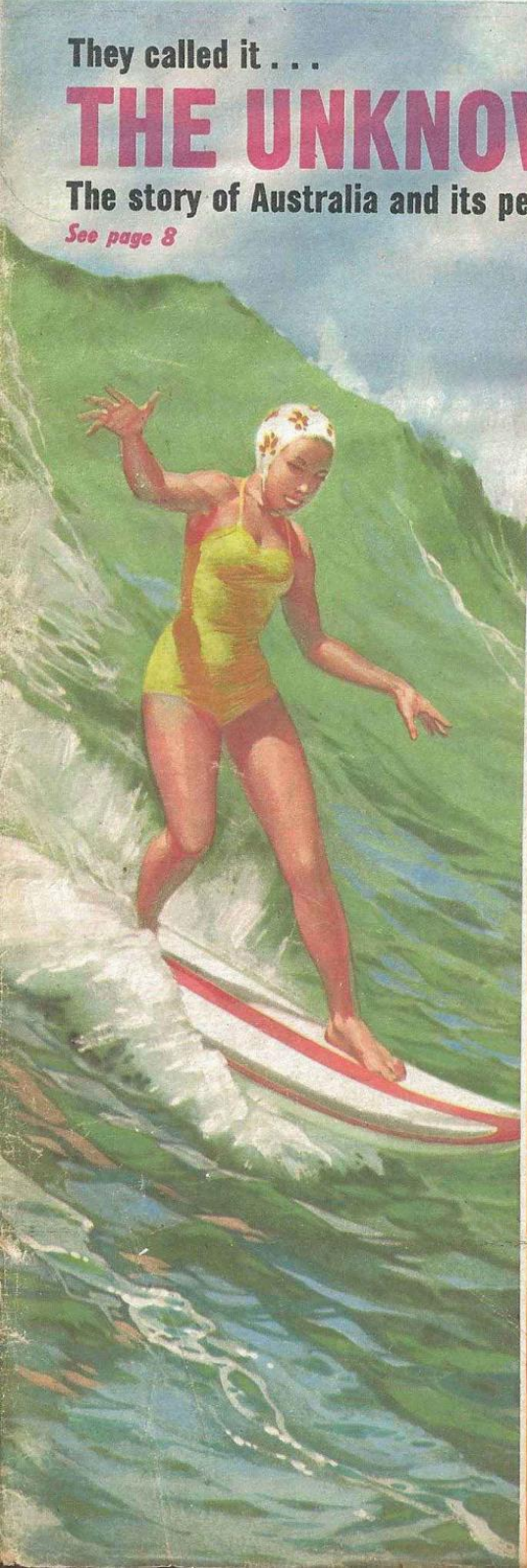
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They called it . . .

THE UNKNOWN LAND

The story of Australia and its people

See page 8



A look at another of man's forthcoming attempts to cross the barriers of space.

MISSION to MARS!

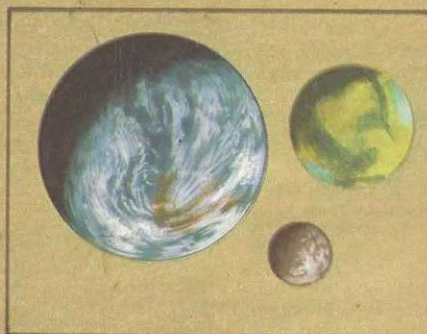
MARS has been a magnet for man's imagination for centuries, and before the end of this century it should give up many of its secrets to spacemen from Earth.

When photographed with natural colour techniques and big reflector telescopes, Mars loses its beautiful and somehow sinister red colour. It appears in softer shades of yellow and green, though still with its burning white polar cap. The "Red Planet," as seen from Earth, is, like the blood-red rising moon or our own spectacular sunsets, merely the result of billions of discolouring particles in the earth's thick blanket of atmosphere.

Other famous features of science fiction's planet Mars are the canals. Some experts now believe these mysterious networks on the planet's face are nothing more than optical illusions caused by the distance from which we view Mars.

If America's space plans continue in their present direction, it is probable that we shall at last know the truth about the mysterious canals, and many of our other questions about Mars before the year 2000. The year of the Mars mission could even be sooner—in 1986 or even 1981-2, according to the priority given by the President and his advisers.

Already, the Red Planet is no stranger to spacecraft from earth. It is being investigated by



The Earth, the Moon and the planet Mars are seen here drawn to the same scale.

unmanned probes just as our own moon was for years before men touched down on its surface. Each probe is more complex and capable of more thorough scientific examination than the last. The main question is always whether or not there is life on the planet, and with each probe we slot into place more of the pieces of the jigsaw puzzle.

Mariners 6 and 7, orbiting Mars earlier this year, sent back some of the answers. They told

us that the atmosphere is extremely thin (equivalent to Earth's atmosphere 100-150 miles up) and is made up mainly of carbon-dioxide, unbreathable to us.

The pictures they sent back show the thin ice-cap, surfaces cratered like our own moon and other areas of curious chaotic wrinkled heights and valleys in which our geological experts can see no apparent pattern or cause.

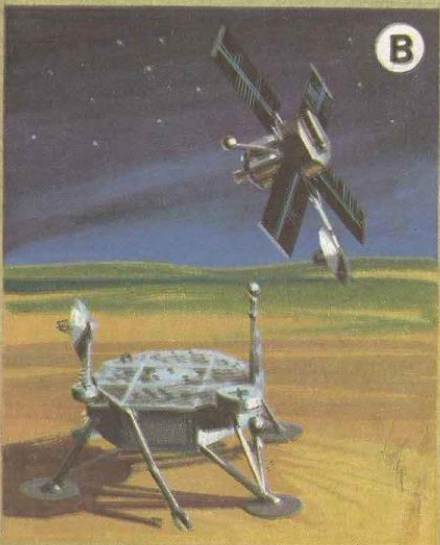
The next *Mariners* will be launched in 1971, followed in 1973 by the more ambitious *Viking* probes which will split into two units for different tasks. The "Orbiter" section will, as its name suggests, swing in a wide orbit around the planet, taking pictures and investigating with sensors. The second, "Lander" section, will soft-land, using retro-rockets, and set to work examining its surroundings on the surface. With its ingenious equipment, it will try to detect Martian life forms, register local weather conditions and surface characteristics. All the findings will be transmitted back to earth.

It is vital, of course, to sterilise any vehicle which is to land on another world (or which may spiral out of orbit and crash on it), to ensure firstly that it cannot contaminate its landing area and secondly that any life form it finds is of local origin!

By the time the manned Mars mission is ready to go it will be forearmed with much vital knowledge—as were the men who landed on the moon.



A



B



C

(A) Designers are still seriously at work on detailed plans for space-stations like the one illustrated above to be in position in the next few years. Once in orbit, they will start programmes of research and practical work. One of their tasks will be to find out exactly how best to accomplish the flight to Mars and back. The Mars ship could be very similar in design to the space station and would indeed probably be boosted up into earth orbit section by section and assembled by men from the station using small "space tugs." If a nuclear or nuclear-electric main engine were used for the Mars flight, it would have to be assembled and fired from outside the atmosphere to avoid contaminations. The large illustration on the opposite page shows the Mars mission approaching its target.

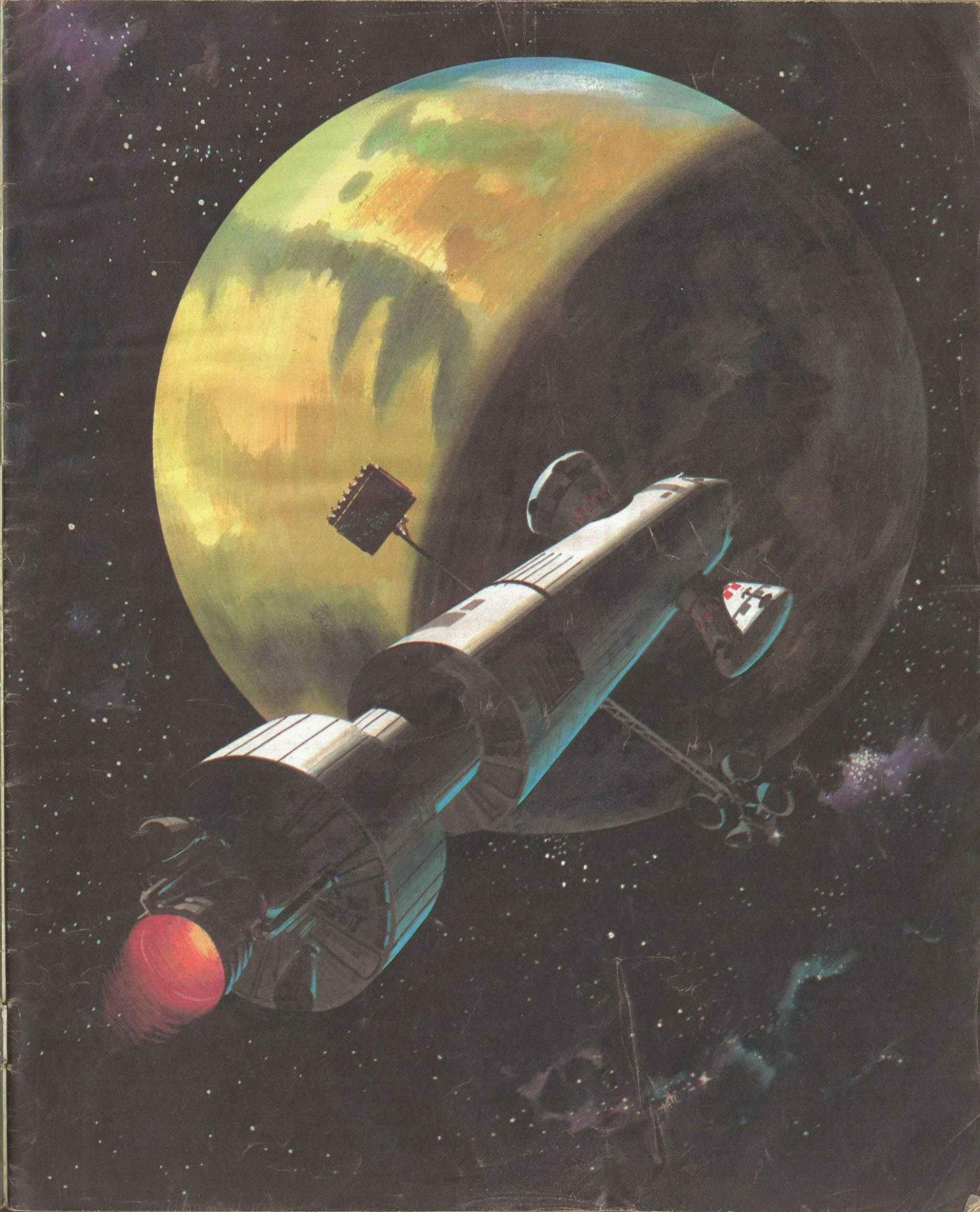
(B) An impression of the "Orbiter" and "Lander" units of the 1973 *Viking* probes to Mars, shown close together only for comparison. Both would transmit information back to earth via their dish-shaped antennae.

(C) For a manned Mars landing, the Apollo moon landing technique will be used. An orbital

craft would send down and later join up again with a specialised landing and take-off craft. In the case of Mars, both parachutes and retro-rockets will be used to slow down and cushion the landing. The landing module will carry an exploration vehicle, and the whole of the Mars expedition will be on a much larger scale than the early moon flights. The time scale alone is enormous. One programme calculates a there-and-back time of 450 days!

The crew's life support suits will probably have to be "hard" or armoured to deal with possible meteoroid strikes. Mars is close to the asteroid belt and is probably bombarded continuously with meteoric lumps large and small. The thin atmosphere will be no protection against them (unlike Earth's which burns them up as they enter it). The carbon-dioxide atmosphere will also mean that complete life support packs for the crew, as in the Apollo programme, will be essential.

The Mars landing vehicle illustrated is part of the McDonnell-Douglas "Deimos" project study, named after one of Mars's two small moons.



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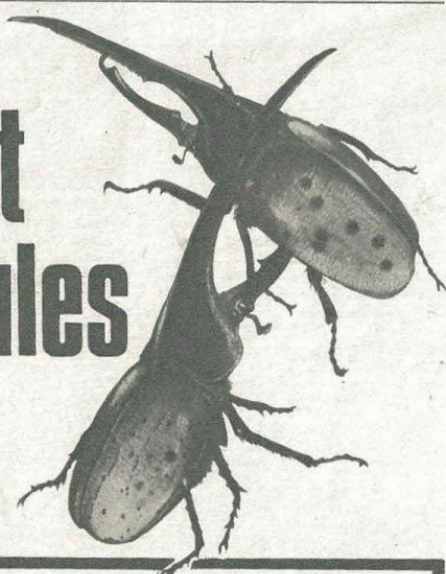
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YOUR WEEKLY...

APPOINTMENT WITH DANGER SABOTAGE!

by NICK COLE

THE loudspeaker crackled, then a voice said: "British European Airways announce the departure of their Paris flight. Will passengers please proceed to the gate, and have their boarding-tickets ready..." Everyone picked up their hand-luggage and moved towards the door leading to the tarmac. A few minutes later, they were settling into their seats aboard the Viking airliner. They chatted to each other about the flight and what they would be doing in France. In the forward section, Monsieur Pierre Robine, a French Naval engineer, was busy fastening his safety-belt; farther back, diplomat Ralph Straus was studying some documents, while at the rear of the plane, Huddersfield businessman, Mr. W. Dobroyd, was reading about teenage "bebop" and the latest items to be de-rated, in the evening papers. All 27 seats were occupied.

The engines roared into life and

the Viking G-AIVL—Victor Love was her call-sign—soon got the control tower's message: "All clear for take-off." In the capable hands of the pilot, 29-year-old Captain Ian Harvey, D.F.C., a wartime bomber pilot, the airliner sped down the runway and lifted off smoothly. The 7.45 flight from Northolt to Paris on that fateful evening of 13 April, 1950, had begun uneventfully enough.

An hour later, they were passing over the South Coast at 3,500 ft. It was a clear, almost cloudless night, with occasional flashes of lightning that lit up the sky vividly. Up front, Captain Harvey and his co-pilot, "Dusty" Miller, checked their instruments and set Victor Love on the automatic pilot. Meanwhile, the Air Stewardess, Sue Cramsie, was serving dinner and hot coffee to the hungry passengers. When this was done, she went back to the tiny galley and sat down for a few minutes' rest. She would shortly take round the duty-

As Sue Cramsie, the air hostess, reached the rear of the airliner there was a violent explosion.



A mystery explosion had ripped two gaping holes in the airliner. Desperately, the young pilot fought to save his passengers, knowing that any minute, the plane might break up and plunge headlong to disaster. . . .

free cigarettes. . . .

Suddenly, she became aware of a peculiar smell. She couldn't place it at first. Somebody's cigar? Leaking fuel? She sniffed, and the fumes made her cough. It was unmistakably acid. But where was it coming from? She decided to investigate. She walked along the gangway, but everything seemed all right. The passengers were talking to one another, and no one was acting suspiciously.

She returned to the galley, puzzled. Then it happened. As she reached the rear of the airliner there was a violent explosion which threw her off her feet and knocked her senseless. The plane shook convulsively and the passenger cabin filled with smoke. Then the plane went into an uncontrollable climb. As Captain Harvey wrestled with the controls, a sudden rush of air cleared the smoke and revealed a terrifying sight: two jagged holes nearly 10 ft. across on either side of the fuselage. And dangerously near one of them lay Sue Cramsie, unconscious beneath a heap of debris.

A passenger rushed to her and dragged her clear. Others began unlacing their shoes, ready to swim for it if the aircraft came down in the Channel. "We must have been hit by lightning! Dusty, go back and see if the passengers are O.K.," said Captain Harvey urgently. As First Officer Miller calmed the frightened travellers, Captain Harvey struggled to get Victor Love back on an even course.

Airport alerted!

Every second it became more difficult. The elevators were jammed solid. The rudder pedals gave no response. The only way he could keep the aircraft level was by wedging his knee between the control column and his seat. A second later, Miller was shouting in his ear: "It's a shambles back there, sir! Half the control rods have gone." A brief inspection had shown him the tail section was now held in place by nothing more than two thin strips of metal, one under the floor and the other along the roof of the fuselage.

Captain Harvey had to think fast. He was trained for emergencies. But never before, even on flak-torn bombing raids, had he faced a challenge like this. Paris was still one and a half hours away. In any direction lay danger; for he knew that one false move by him, one inadvertent wrench at the controls, and the whole structure would break up in the air.

Instinctively, he reduced speed from 170 knots to 135, then turned to Miller and yelled: "Get through to Ground Control. Give them this message: 'Have been struck by lightning. Stewardess seriously injured. Returning to Northolt. Have ambulances standing by'."

Gradually, very gradually, he

nudged the joystick to port and eased the aircraft round. Then, with a torn part of the fuselage clattering against its side, the crippled aircraft began to limp slowly homewards in a long, straight approach at 2,500 ft.

Back at Northolt the authorities immediately ordered a full-scale emergency for a crash landing. All other aircraft were banned from the zone, and fire engines and ambulances waited by the runway. Officials watched anxiously as the lights of the airliner came nearer and nearer to the runway. Then, when it was less than 20 ft. off the tarmac, they heard the engines rev up to full power to avoid stalling.

The Viking roared back into the

darkness and circled slowly round for another landing attempt. This time, the airliner came in on a more shallow approach and lowered gently to the runway. The tyres gave a screech as they made contact. The plane was safely down!

When the passengers had been shepherded to the lounge, Victor Love was towed away to a closely-guarded hangar for a minute inspection. The officials could hardly believe their eyes: "It looks just as though it's been hit by an anti-aircraft shell," said one. Apart from the two holes, the door had been blown off and the galley and toilet wrecked.

Had Captain Harvey—"Try-Again Ian," as the papers dubbed him—

known the full extent of the damage, it is unlikely he would have attempted a crash-landing. The strain of the "overshoot" alone could have snapped the tail clean off. As it is, he made it and to this day is still working for B.E.A. Sue Cramsie, after a stay in hospital, returned to her old job as a stewardess. Of one thing, the officials were now certain; whatever had caused the damage, it wasn't lightning. Twisted metal round the holes showed the fuselage had been blown outwards.

An official enquiry confirmed that "an explosive object" had almost certainly been detonated in a towel-box in the toilet. But who planted it, and why, remains an unsolved mystery.



"It's a shambles back there, Sir!" First Officer Miller shouted.

LOOK AND LEARN ENTERTAINMENT SUPPLEMENT

MEN AND MACHINES

JET SEAT!

A PILOT forced to leave his aircraft in an emergency may land safely by parachute. But he may be in danger if he comes down in mountains, a jungle or in a desert.

To give pilots a chance of reaching safety, the United States' Air Force and Navy are working on two systems to enable a pilot to fly his ejection seat for 50 or more miles from the crash area.

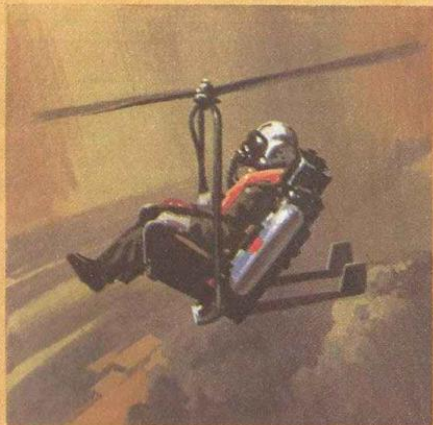
Both systems use miniature jet engines for forward thrust, but different lifting devices to enable the seat to stay in the air. The first "flying seat" (shown right) uses a *parawing*, and its sequence of operations is shown, right to left, in the smaller pictures below.

The pilot ejects at about 1,000 ft. above the ground. Next, the parawing unfolds on its telescopic framework and the jet engines start automatically.

Under jet power, the seat climbs quickly to about 10,000 ft., and the pilot uses two hand controls on the seat to adjust the parawing's angle and so control his flight path. When the jet fuel is exhausted, the seat continues to glide forward and downwards, but still under control. When the pilot judges that the time and height are favourable, he releases himself and uses his parachute to land.

The second seat design (below) is kept in the air by a two-bladed 16 ft. diameter rotor which is folded and telescoped for cockpit stowage. It is spun up by the airflow over its blades and the pilot flies it with a hand lever, just like an autogyro, by tilting the rotor disc.

This flying seat has a top speed of about 105 mph and will glide for long distances after the jet engines have stopped. The small fins behind the seat-back are stabilisers.



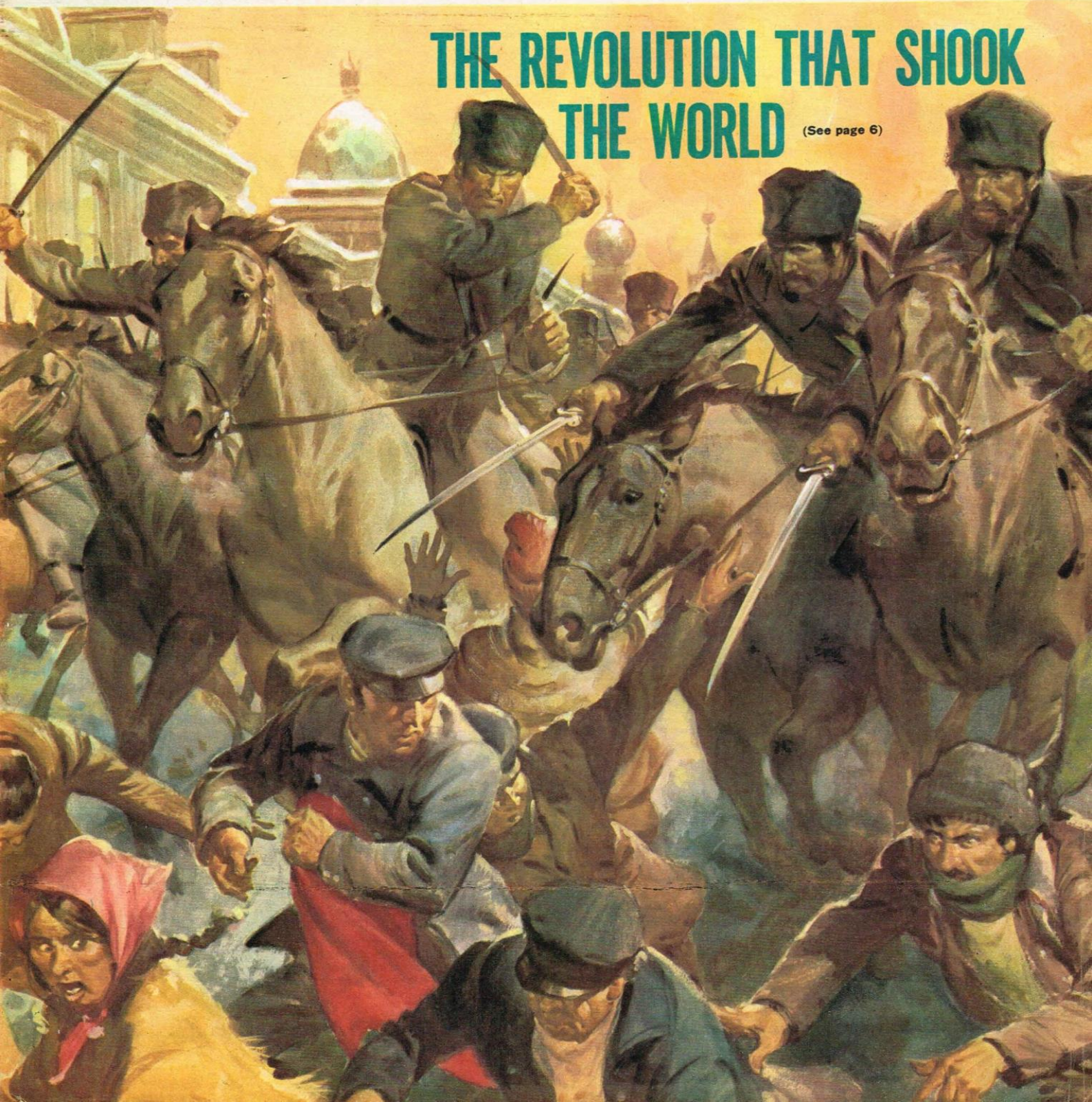
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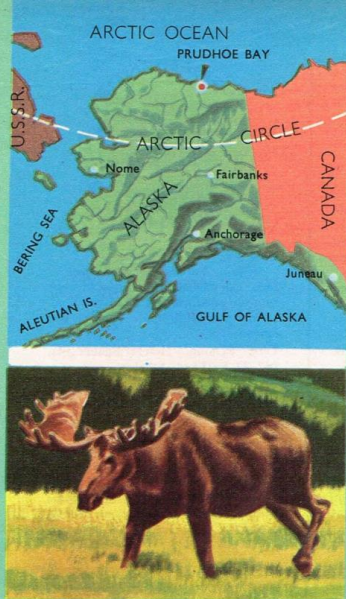
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THE REVOLUTION THAT SHOOK THE WORLD (See page 6)





When freshly fallen snow has carpeted a garden, few people can feel anything but a sense of disappointment when it is gradually kicked and trodden into untidy patterns of slush. There is a similar feeling among oilmen about wanting to protect nature's unspoiled look in Alaska. Of particular concern is how the territory's wildlife will fare against this new onslaught of technology. Though this part of the Arctic has not been widely used by people, it is extensively used by great numbers of animals. Bird-life is varied and interesting, caribou run free in huge numbers, and round the coast there are polar bears, whales, seals, walrus and sea otters. Only with the greatest care will man be able to overcome the threat he is making to Alaska's wildlife. Careful supervision in construction, great efforts to prevent pollution and constant reappraisal of every circumstance will be essential as work progresses.

OIL RUSH!

It was only very recently that Alaska began to lose its air of mystery and isolation. Because of the recent discovery of oil there, its familiar "last frontier" atmosphere is gradually vanishing.

Although it is the largest state in the U.S.A., Alaska has the smallest population and has remained relatively unknown for years. A land of mountains, volcanic peaks, fjords and extensive lowlands, it covers an area nearly one-sixth of the rest of the United States, but it has always deterred any but the hardiest of settlers.

In its 586,400 square miles, there live only 300,000 people, of whom the great majority live in the principal towns. The rest of the vast territory is left to the Alaskan natives—Eskimos, Aleuts and Indians—who live in widely scattered settlements and exist mainly by fishing and hunting.

Furs, fish, timber and minerals have been the greatest mainstays of Alaska's economy and still are—but now the discovery of oil has revealed a broader horizon for Alaska.

It was known by the early fifties that oil was to be found there, but early surveys in the north suggested that its exploitation was uneconomic. Not until recent years has there been any extensive commercial development.

As important as anybody in this new Alaskan "Oil Rush" is *British Petroleum* which has been carrying out geological and geophysical investigations in Alaska since 1959. Eventually their interest was narrowed to two major areas, each about 20 square miles in extent, on the Arctic coast. One of them in Prudhoe Bay, has revealed what could well be one of the world's largest oilfields, though more tests need to be conducted to confirm the find.

But now come the problems. The actual climatic conditions in which exploration and drilling have to be carried out are probably the worst to be found anywhere in the world. Temperatures can drop to as low as — 87°F at times, and great care has to be taken. The men have to work in special winter clothing, and their equipment, which can easily freeze up or become so brittle that it will snap, has to be especially carefully handled.

There are other snags in attempting to exploit oil in Alaska. Providing supplies is one of them.

The bulkiest have to be sent by sea, using the route through the Bering Straits. As this is navigable for only six weeks of the year, deliveries have to be carefully worked out. Though aircraft can be and are used throughout the year, flying conditions are always hazardous. Frozen fog and the disappearance of the horizon, for instance, can make visual direction finding extremely tricky.

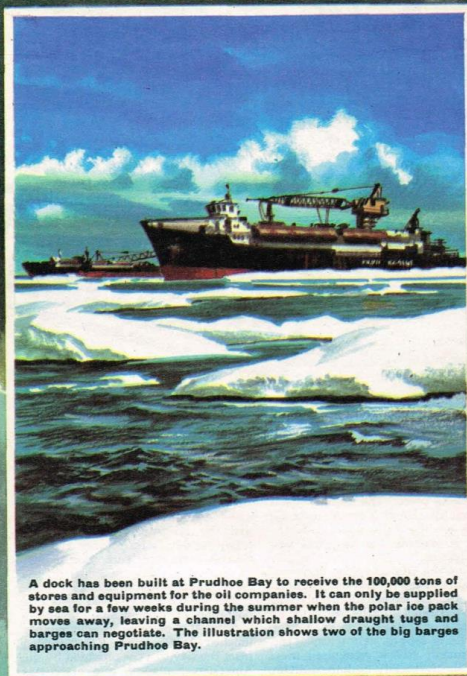
Moving equipment around presents a different kind of problem. Because of the very short growing season, it takes many years for damage to the landscape to be restored, and great care has to be taken to prevent disturbance to the surface by heavy track vehicles.

The need to preserve the tundra, Alaska's natural vegetation, has given *BP* an extremely ingenious idea. At present, it moves its rigs by dismantling and transporting them along specially built gravel roads, a process which can take up to three weeks for each rig. Now, however, *BP* is examining the possibilities of a hovercraft device.

Hover carrier

If eventually adopted, it would not only be able to move a rig in one piece without damaging the tundra, but it would also provide much greater freedom of movement and speed up schedules. With a hover carrier (see main illustration), the moving of a rig could be completed in as little as three days, a time saving of between 2 and 2½ weeks. Fewer rigs would be required.

Two air cushion devices are being considered, the most promising of which incorporates a catamaran-type structure using two hovering units, each 112 ft. by 52 ft. These would be joined together by two outrigger cantilever beams which in operation would be threaded through the rig sub-structure. The air cushion system would be powered by eight (four per hover unit) symmetrically placed 1,000 h.p. diesel engines, and movement of the airborne rig would be by two specially designed low ground pressure tractors. Two other tractors would travel behind to provide stability. Complete rig movements are expected to be possible in any wind under 20 knots.

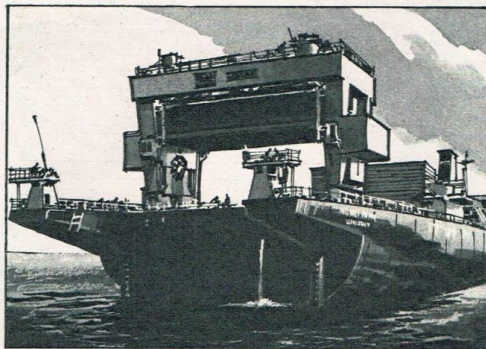


A dock has been built at Prudhoe Bay to receive the 100,000 tons of stores and equipment for the oil companies. It can only be supplied by sea for a few weeks during the summer when the polar ice pack moves away, leaving a channel which shallow draught tugs and barges can negotiate. The illustration shows two of the big barges approaching Prudhoe Bay.





NEW ANSWERS FOR OLD PROBLEMS



THE SELF-LOADING SHIP

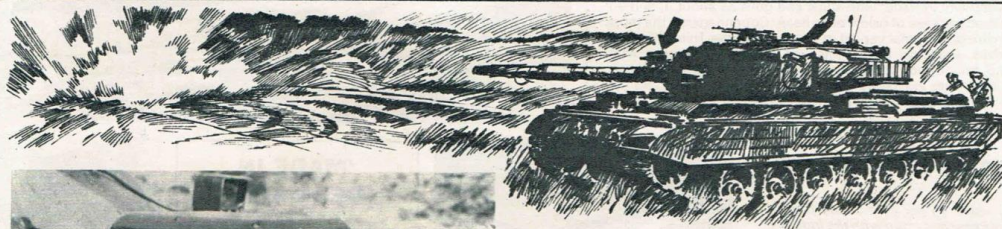
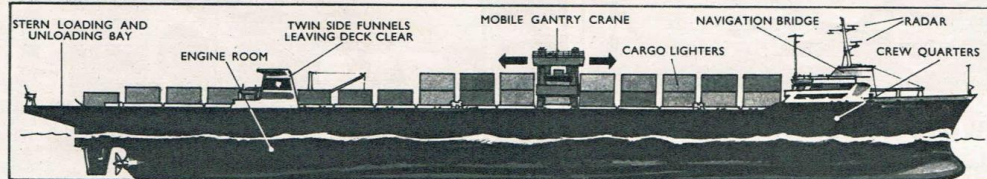
When the Japanese-built *Acadia Forest* was delivered to Norway in September this year, it was a significant breakthrough in the transportation of ocean cargo.

The ship differs from other cargo craft in that it consists of a mother ship and a fleet of lighters—or barges—which are separately loaded with cargo in advance of the mother ship's arrival in port. When it arrives, the lighters are brought alongside and hoisted into the mother ship's holds by the vessel's own shipboard gantry crane. On arrival at the destination port, the reverse procedure is used.

The advantages over other cargo ships are several. The time the mother ship will have to stay in port is drastically reduced (by as much as 70 per cent, it is claimed), the need for deep-draught berths is eliminated, as the vessel will be able to stand-off small ports and estuaries while being loaded, and thus it will be able to avoid the congestion that has arisen in many ports.

The ship's main engine is a Urago-Sulzer 9RND90 unit of 25,000 b.h.p., which is located in a semi-aft position. Dominant feature of the barge handling arrangements is the deck-mounted gantry crane of 500 tons lifting capacity, which is by far the largest on any ship.

Left is the Japanese-built *Acadia Forest* with (below) a sketch showing the vessel's main features



CUT-PRICE TARGET PRACTICE

One thing about training an army to look after itself in battle is that it costs money. And the trouble is that the army can't win, whichever way it sets about things. If it spends too much money on practice, the taxpayer wants to know why. If it isn't up to scratch in actual combat conditions, it risks defeating its purpose.

The latest in economical warfare training techniques is the development by British scientists of a laser projector. This enables gunners to get accurate target practice without having to fire expensive blank shells, which cost about £75 each.

What happens is that the laser projector is strapped to the tank's gun barrel. The gunner takes aim in the normal way, fires, and if he scores a direct hit, the "enemy" tank goes up in smoke. Opponent tanks are equipped with receiver devices which emit smoke charges when hit by the laser beam.

Known as "Simfire," this revolutionary laser method is produced by the Solartron Company of Farnborough, Hampshire, and is at present being tested and evaluated by the Ministry of Defence. It is already arousing a great deal of interest throughout the world.



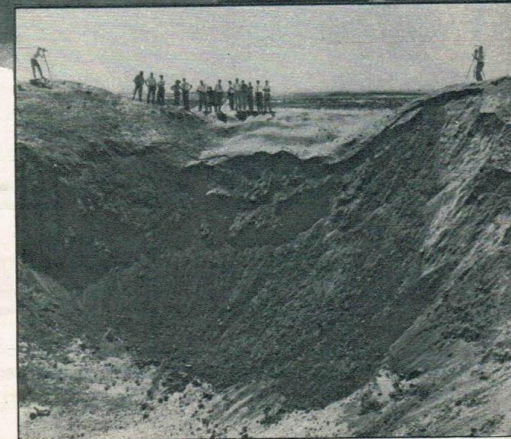
NUCLEAR AGE CANALS

Imagine sailing all the way round the body of either South America or North America to deliver cargo. It's a long, long way. Other people realised the fact, and so there was built the Panama Canal—an artificial waterway which stretched through the isthmus of Panama and connected the Caribbean with the Pacific Ocean.

Construction was completed in 1913 at a cost of 380,650,000 dollars, and it took between seven and ten years to build. The lack of certainty here is because it is difficult to say how much of the time was spent on the actual construction and how much was absorbed by adjusting to problems which at the time were new or particular to the time. Political questions and lack of knowledge of the terrain all provided separate problems.

However, even taking the minimum period of construction, it was a long time. And now, while plans are afoot for cutting a second canal across central America, there is a good deal of concern about ways of doing the job more quickly and cheaply.

Already scientists are performing experiments in the desert of New Mexico to develop a technique for *atom blasting* a canal. Being carried out by the Sandia Corporation, the use of nuclear explosives is said to provide a much cheaper and quicker way of creating a channel than the conventional means used so far.



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THE STORY OF THE CHRISTMAS TREE

See page 8

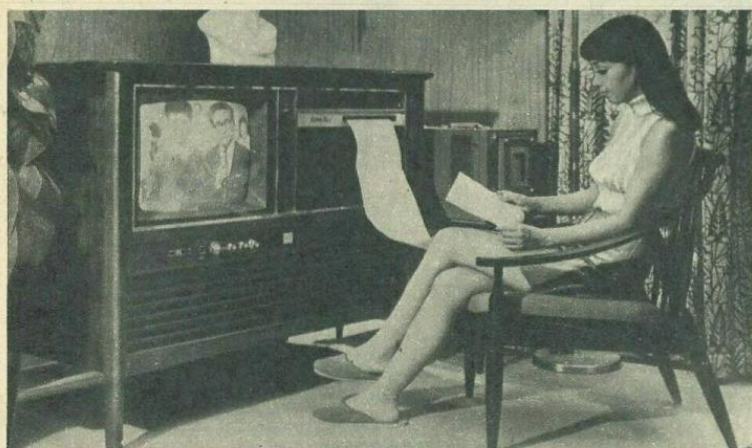
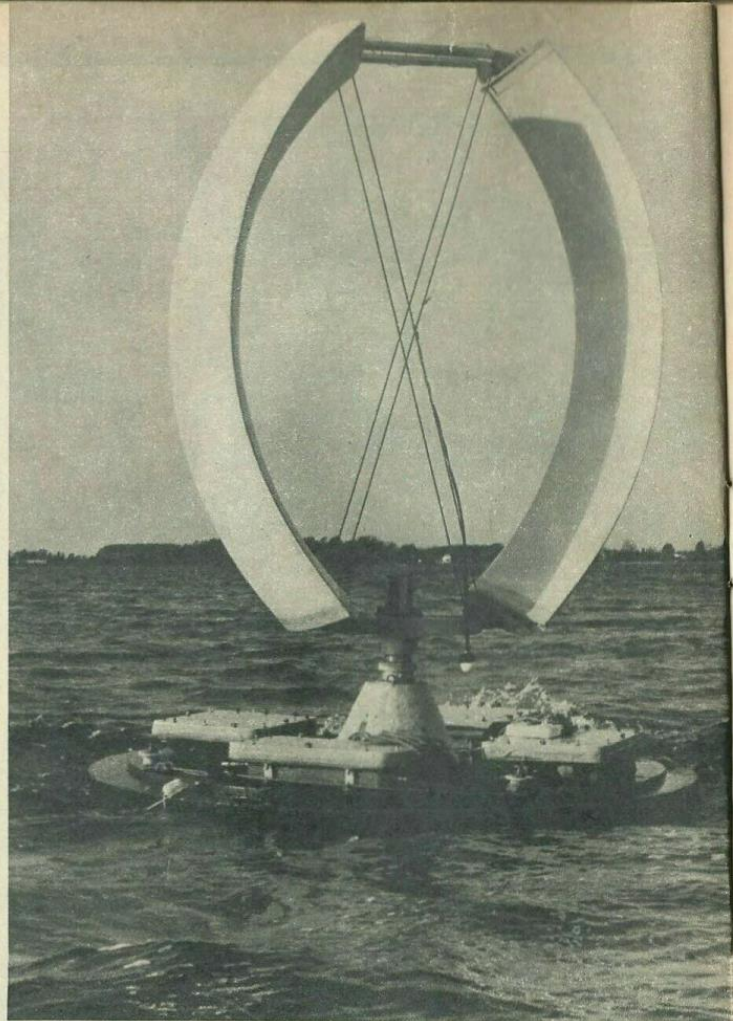




LOOKING INTO SCIENCE

THE GO ANYWHERE BOAT

Under development at present is a revolutionary sailboat which will be able to navigate itself to any point on the world's seas and perform oceanographic, meteorological and other missions. Said to be capable of remaining on station automatically for up to a year without a mooring, this unmanned sailing craft promises to perform its mission more effectively and at less cost than any other oceanographic systems yet invented. The buoy-like vessel, called SKAMP (Station Keeping and Mobile Platform), uses computerised electronic navigation and a combination of movable air foils and rudders. It will be able to sail unmanned to a pre-determined location and stay there unattended for up to a year until commanded by radio to return or move to another station. Built in Princeton, New Jersey, the craft has unique moulded sails made of foam filled plastic.



HERE IS THE NEWS—FROM YOUR TV DELIVERY BOY

This Japanese girl is reading the news, which isn't unusual. But it is being delivered through a slot in her television set, which *is* unusual! This new TV set, which can give printed news to viewers instantaneously, has been developed by a Japanese electronic company and is expected to go on sale to the public some time in the first half of 1970. Already dubbed the "wireless newspaper", it is the forerunner of a home facsimile machine which will provide households with printed information more swiftly than the present newspaper delivery system.

A REAL SUNDAY AFTERNOON "SPIN"

"This is the car that can run rings round its rivals—literally." That was the claim of a 23-year-old Scots student, Dawson Sellar, when he introduced his city car to Ford of Britain. And to prove his claim, he slotted the unusual looking machine into an 'impossible' parking space, put it into first gear, spun it round on the spot without touching either of two new cars parked on either side, and accelerated away.

61 inches long and 48 inches wide, the city car is intended for use in congested areas. Capable of carrying two adults and their shopping at a maximum speed of 40-45 mph with its present 150 cc 6 bhp two-stroke engine, which drives the rearmost wheel only, the car's main advantage is its incredible manoeuvrability. It can rotate about its own centre because of a system whereby it steers through the wheels on one side only without going along crabwise. The system is so effective that the car isn't even fitted with a reverse gear.

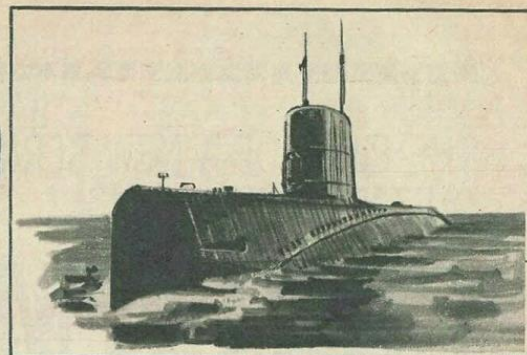


FUEL FROM ROCKS

On your right, you can see a cube of granite, a hard rock quarried from the Rocky Mountains, and next to it is a larger black cube of coal. In the past the coal could be burned to yield useful energy in the form of heat to drive trains, generate electricity or just keep us warm in winter—but nothing much could be done with the granite, except perhaps in the construction of buildings. Certainly nobody ever thought of rock as being a useful fuel.

Today, however, the development of nuclear power is gradually turning all men's ideas about fuels upside down. That granite contains very small amounts of uranium and thorium—about four parts of each to every million parts of rock—and uranium and thorium have become very important in the nuclear age because they can be used in nuclear reactors to generate heat, just as in the old days coal was used in furnaces.

Today new reactors, known as *fast breeder reactors*, can produce not only heat but also fresh nuclear fuel. In fact, some can make fresh fuel even faster than they burn up the original fuel! That cube of granite, then, is today regarded as a source of energy ten times richer than the coal.



A nuclear-powered submarine—another example of the way atomic energy can be harnessed and put to use.

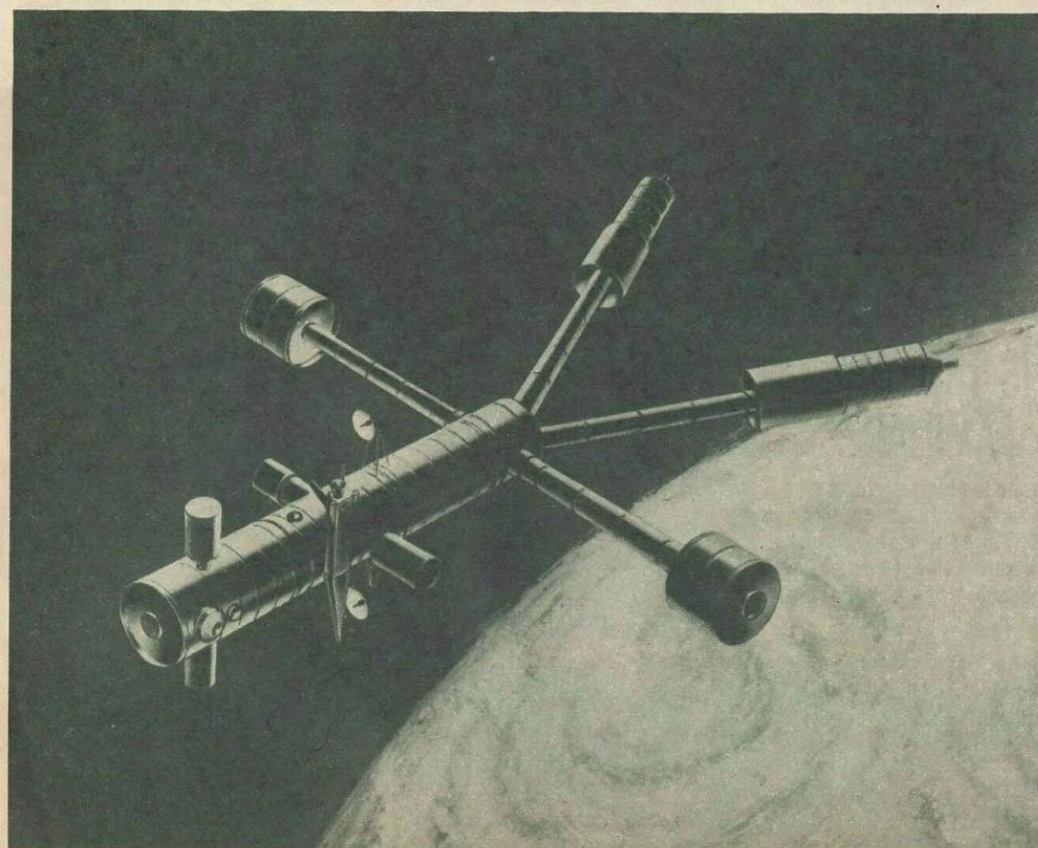
SPACE BASE—1980

As far as we know, the conditions that enable life to exist on Earth are unique within our galaxy. But those same conditions also make it difficult to escape and return to our planet. Launching each space-craft with a mighty rocket, to escape Earth's gravity, and later retrieving the returning space capsule cost millions of pounds and man-hours.

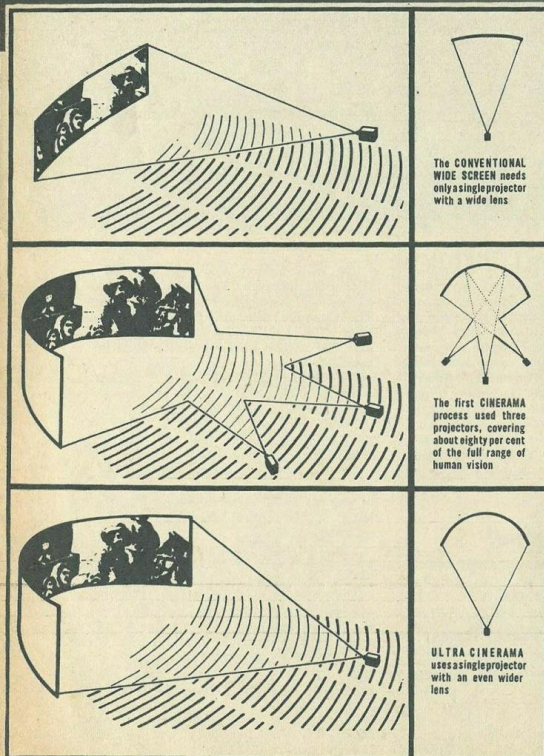
It is obvious then that space stations orbiting the earth would offer tremendous advantages. They could serve as research laboratories, re-fuelling bases and maintenance posts for weather and TV satellites, among other things.

Now the race to the Moon is over, space programmes will in future concentrate on perfecting the manoeuvres and extra-terrestrial skills which will enable working space stations to be built.

The illustration gives some idea of the appearance of a fifty-man space base being developed by American scientists and engineers. Designed by McDonnell Douglas Astronautics, it would be made up of specialised modules assembled in low earth orbit and could be operational by the early 1980s.



THIS IS CINERAMA



Hollywood's answer to television was the gigantic Cinerama screen.

ONE evening in September, 1952, some 1,000 people gathered in a Broadway Theatre in New York, to see a film which was frankly admitted by its sponsors to be an experimental production. The lights dimmed, and the curtains drew slowly back to reveal an expanse of screen six times larger than the normal screen. A few seconds later, the audience was gasping with excitement as they swooped and dived with a camera which had been attached to a roller coaster.

What the audience were seeing that night was the first public performance of Cinerama, Hollywood's answer to television, which had been luring audiences away from the cinema in their thousands.

But what, in fact, is Cinerama? It was originally the brainchild of an American engineer, named Fred Waller, who had started his experiments as far back as 1937. Waller began with the realisation that we judged depth by the sight out of the corner of our eyes. Peripheral vision it is called. What he was seeking, therefore, was to create a process which would give the illusion of reality by making the audience feel that they were not, in fact, in a cinema, but actually watching or taking part in an event. The illusion of reality created by Cinerama, therefore, had to be closely linked to the function of the retina of the human eye and the drum of the human ear.

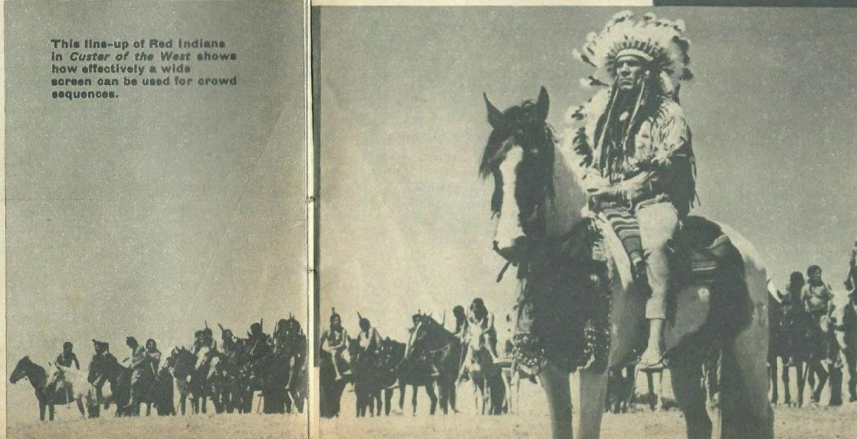
Fred Waller had taken on what must have seemed an almost impossible task, when you consider that, while a person's attention may be directed primarily at one particular object, their field of vision also encompasses everything on either side of it. Likewise, a person walking

down a city street, for example, hears not only the sound directly in front of him, but also that on either side of him and behind him. To bring this into a cinema would have meant building a screen that was literally a mile wide. Waller finally solved this difficulty by curving the screen in the same way that the retina of the eye is curved.

The genesis of Cinerama was, however, a painful one. In 1939, Waller created for the World's Fair, a form of Cinerama which had a curved screen and a dome that hung over the front of the audience. No less than eleven projectors were needed to throw the image on the screen. The World's Fair never used the idea.

The next advance did not come

This line-up of Red Indians in *Custer of the West* shows how effectively a wide screen can be used for crowd sequences.

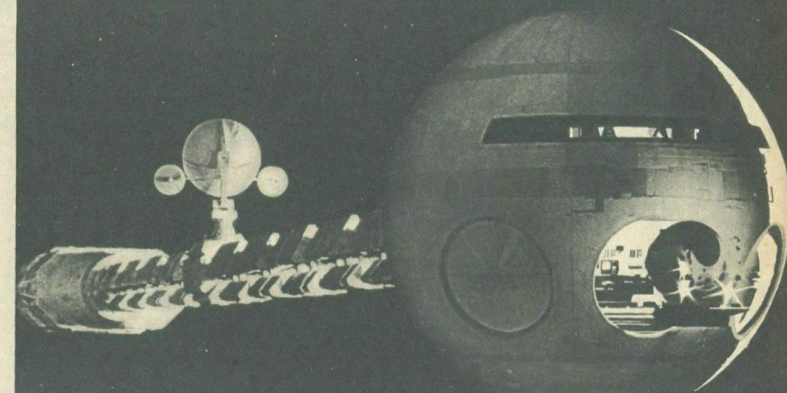


The full fury of an erupting volcano makes up an exciting sequence in the film *Krakatoa—East of Java*, one of the more recent Cinerama epics.

until after the war, when the possibilities of stereophonic sound began to be investigated more closely. After a great deal of experimental work, a system was evolved that used seven sound tracks, which meant that whatever film was taken, the sound would be tied to the object or person being photographed. This was called 'directional' sound.

Finally, by the Spring of 1949, the new equipment was complete, and a few short demonstration films were made, and shown to the professional film-makers—who turned it down in the same way that they had first rejected the idea of sound.

By 1950, the situation had become so desperate that it was proposed that the company should be liquidated. Then, just when it seemed as if all the



years of work had been wasted, various people suddenly became interested, and a small group of them got together to make the first Cinerama film, *This is Cinerama*. After several other travelogue films had been made, Super Cinerama was conceived. This was simply the creation of a new Cinerama screen which became the fourth wall of the cinema, reaching from floor to ceiling and from wall to wall. Even at this stage, most of the people in the cinema industry believed that Cinerama would be limited to travel features and special subjects. In actual fact, Cinerama moved on to use this mammoth medium for the telling of dramatic stories, which have included *Grand Prix*, which took audiences on to the racing track and the awe-inspiring 2,001—*A Space*

The wide screen process is seen to its best advantage in the awe-inspiring 2,001—*A Space Odyssey*. In this scene an inter-planetary space ship is shown.

Odyssey.

In the early days of Cinerama, the giant screen was covered by three projectors and, although they gave a tremendous three-dimensional effect of audience participation, one was able to see the two joins between the three projectors and, in many cases, people found this distracting.

The problem was finally solved by the invention of the giant Cinerama single lens, which is able to create a three-dimensional effect with perfect clarity of vision over the entire screen, and yet, with one projector still fill the same area of screen previously covered by three projectors.

LOOK LEARN **40** PAGES

No. 416, 3rd JANUARY, 1970

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THE GREAT ADVENTURE

(See page 13)



LOOKING INTO SCIENCE



BREATHE OUT—It isn't a new ball game...

American scientists are not preoccupied only with the exploration of space. They are also determined to conquer the depths of the ocean.

Already a building of spherical rooms has been planned for the mid-Atlantic Ridge—an under-water mountain range which runs from north to south at an average depth of 6,800 ft.

Currently being tested, each of these habitable spheres is 12 ft. in diameter and is made of glass, ceramic and titanium, and they will be used as deep ocean laboratories and observation posts. Being developed by U.S. companies Corning and General Electric, it is speculated that the operation called "Bottom-Fix" will eventually produce a station which will

be used at a depth of up to 20,000 ft.

...BUT NOW BREATHE IN

You might be forgiven for thinking that the gentlemen on the right are taking part in some new water pipe smoking ritual, but you would be wrong.

They are testing an emergency breathing apparatus to be used in the *Deep Quest*, a research submarine being developed by Lockheed Missiles and Space Company. Designed from a combination of aerospace and undersea equipment, it would supply the needs of four men for three hours—more than enough time in which to bring the submarine to the surface from even a depth of 8,000 ft.



LOOK LEARN 40 PAGES

No. 421, 7th FEBRUARY, 1970

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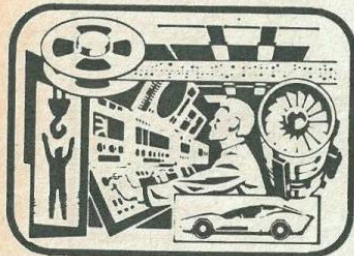
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SEARCH FOR A LOST CITY

See TRAVELLERS' TALES on page 6

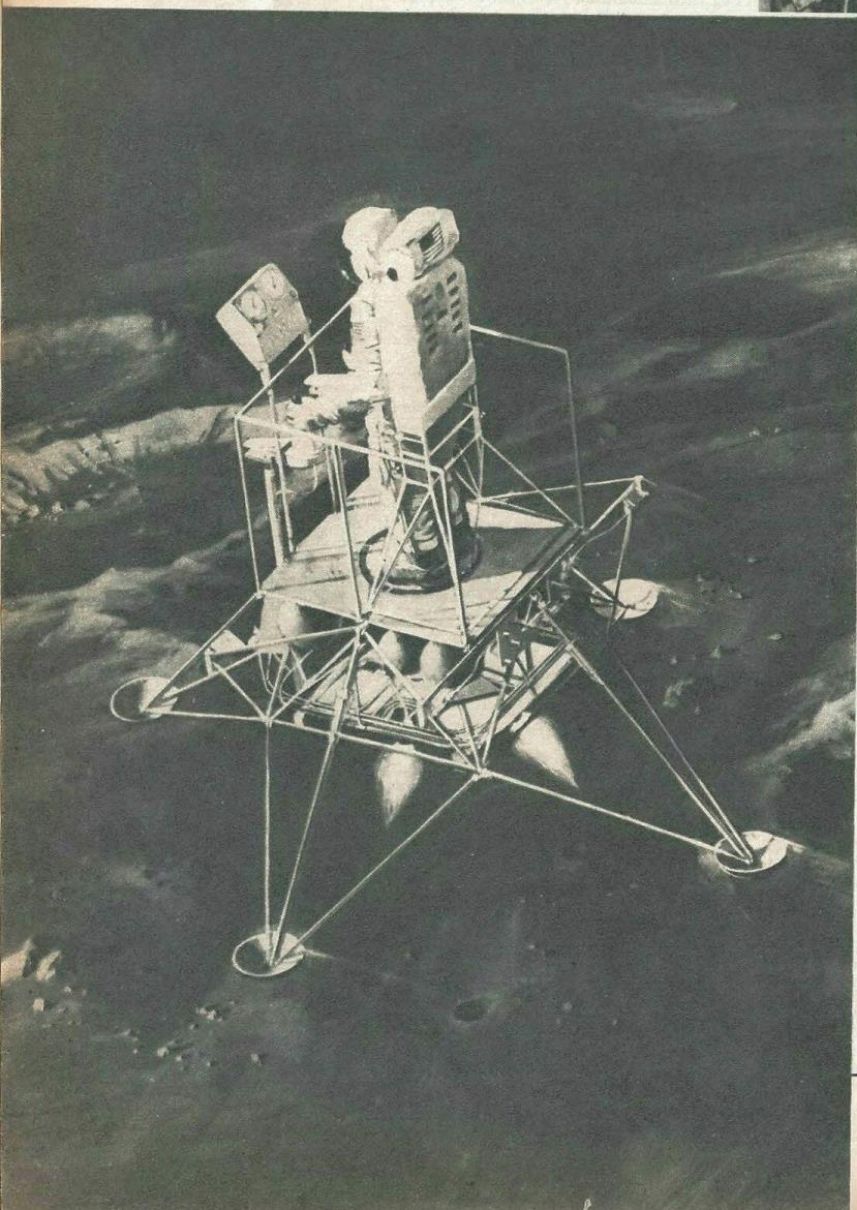


LOOKING INTO SCIENCE



MOVES ON THE MOON

Man has walked on it, and now he wants some mechanised comfort up there. Some of the vehicles have already been developed—as we see here.



ASTRONAUTS Pete Conrad and Alan Bean obviously enjoyed their two long spells of work on the moon's surface. They hopped, skipped and jumped around, and joked and laughed. But it should be even more fun for the moon explorers of 1971, for they will have their own lunar jeep to run them around.

The first version of a lunar roving vehicle (seen above) will be used on the last four Apollo missions (Apollo 17-20) and will allow crews to carry out a much fuller exploration of the areas in which they land. The lunar jeep has been kept as small and light as possible. Though it weighs about 1,300 lb. on earth, its weight in the one-sixth lunar gravity will be not much over 200 lb.

With a top speed of 10 mph, it should be able to range as far as 10 miles from the landing craft, though it is unlikely to travel so far on its first missions. A noticeable feature of the lunar jeep is its wire-mesh wheels, each driven by a separate battery-powered electric motor.

However, when it comes to covering really big distances on the moon, astronauts of the future will have to hop from point to point, as we do on earth by helicopters. So, in addition to the roving vehicles, the United States has been experimenting with personal flying vehicles of various types.

One of their latest ideas (left) is a one-man flier called *Fleep*—or Flying Lunar Excursion Experimental Platform. Developed by North-American Rockwell, builders of the Apollo command and service modules, it would make hopping around the moon an easy matter. The rough surface would present no hazards, apart from landing. Nor would the lack of atmosphere be a problem. The vehicles are kept aloft by small rockets, using hydrogen peroxide as fuel.

SHUTTLES IN SPACE

WHEN the present series of Apollo missions ends in 1972, it is expected to be followed by a series of extended missions, in which astronauts would stay for three days or so on the moon's surface. But after that—what?

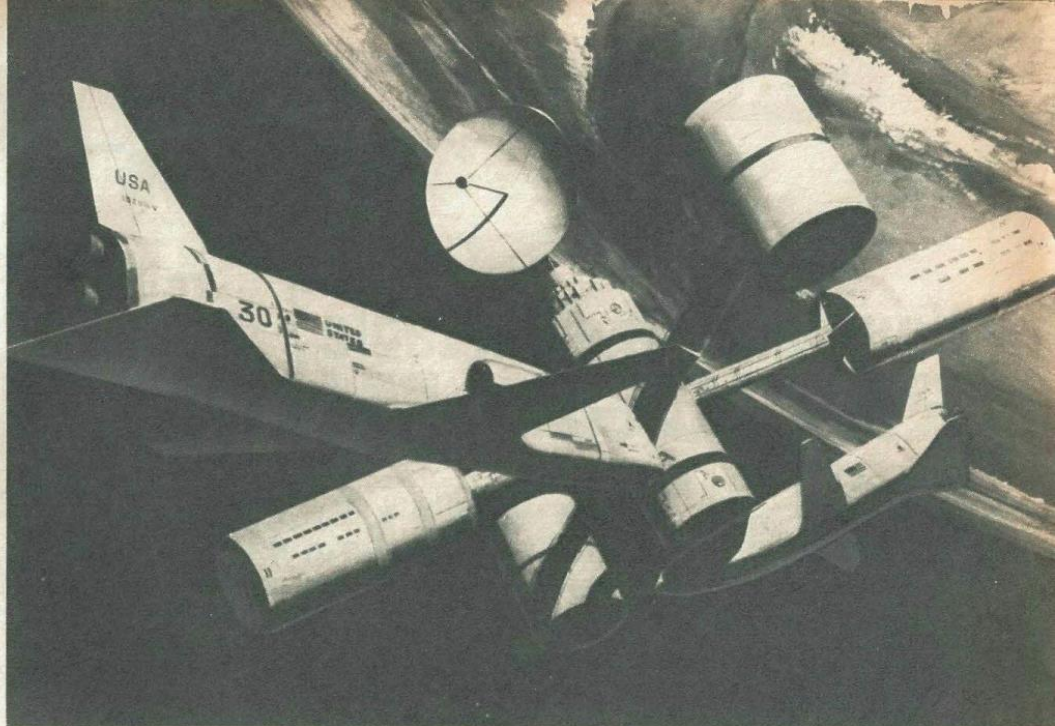
The obvious step is the development of space stations, which we have already mentioned on a previous science page. However, if these were to function properly during their expected life of about 10 years, a primary need would be a completely new space transport system consisting of re-usable vehicles, which could ferry crews and cargo to and from the space stations. Design studies on such vehicles are already being carried out.

As at present envisaged, space shuttles, as they are called, will be powered by rocket engines, take off vertically from a launching pad, and will consist of an orbiter vehicle and a booster element.

The orbiter vehicle will contain crew, passenger and cargo accommodation, as well as fuel for the orbital and landing phases of the mission.

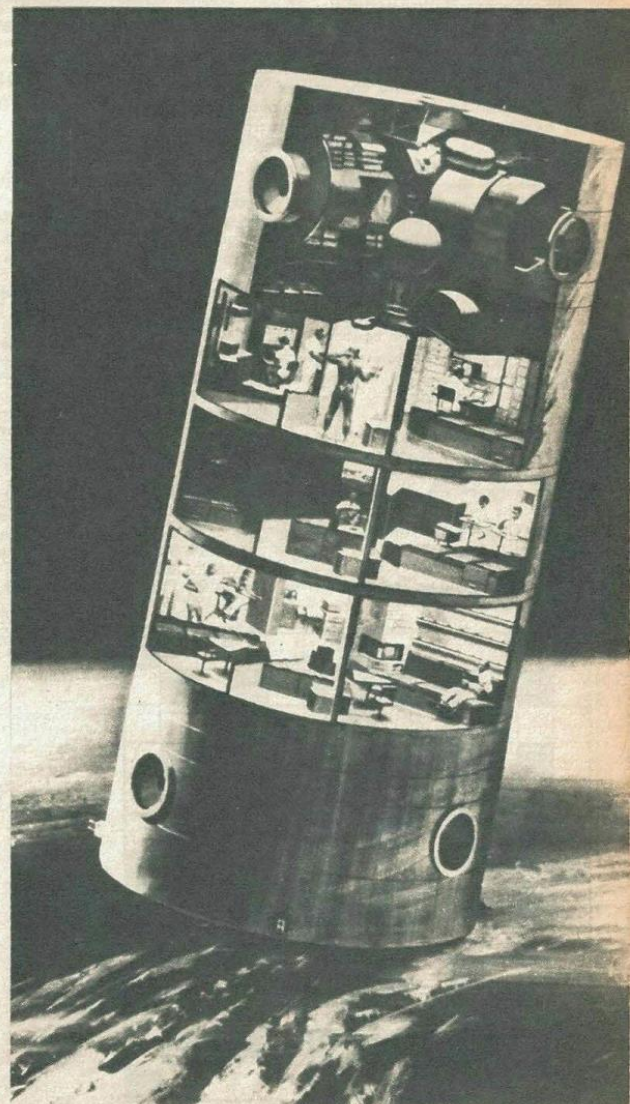
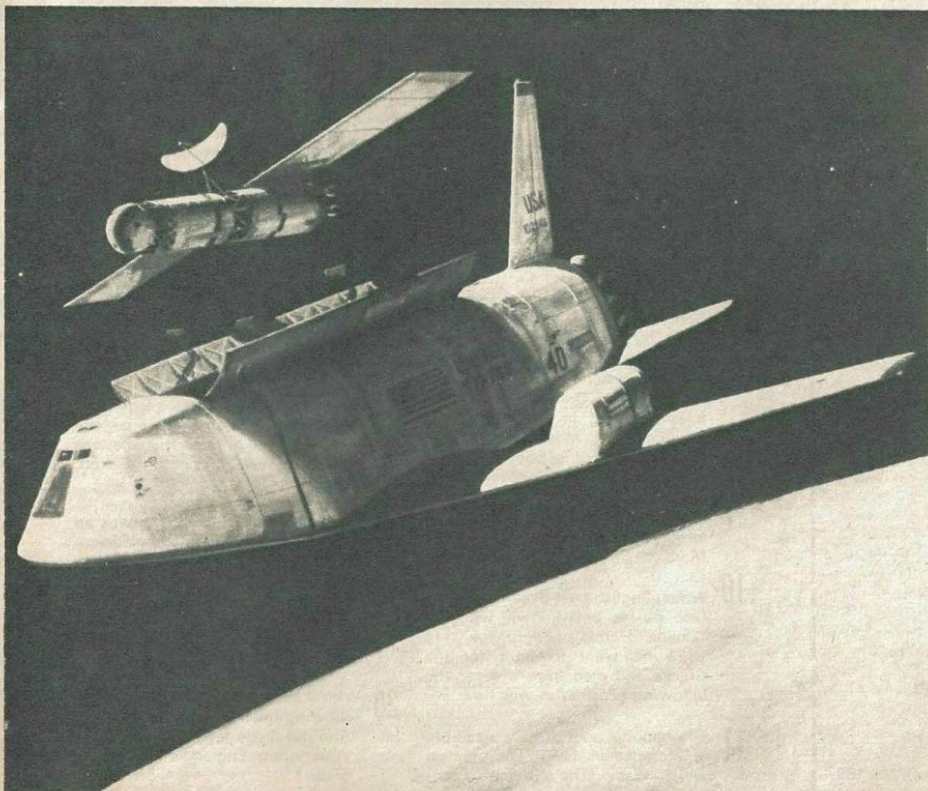
The booster will carry the fuel needed to achieve orbit. It will also be manned, and have a power system which will enable it to return to earth and make a horizontal landing on an airport.

Once an easy line of communication has been developed between space stations and earth, long standing research in physics, biomedicine, astronomy and into the effects of space conditions on men, could be carried out far more easily and profitably. Expected to be developed by the end of the 1970s, the space station and shuttle are the keystones to the next major accomplishment in space.



The illustration above shows two giant winged shuttles delivering men and cargo to an orbiting space station before returning to earth.

The space shuttle concept below comprises an orbiter and a large booster. Each winged vehicle would re-enter the earth's atmosphere at a nose-up angle of 60 degrees, then pitch over to glide attitude for conventional flight. Right: A concept of a 12-man space platform in earth orbit, which the United States is studying as a possible support vehicle to land men on Mars. The circular openings are docking ports for shuttle rockets. Interior facilities include control area, equipment laboratory, exercise room and quarters.



LOOK LEARN

40
PAGES

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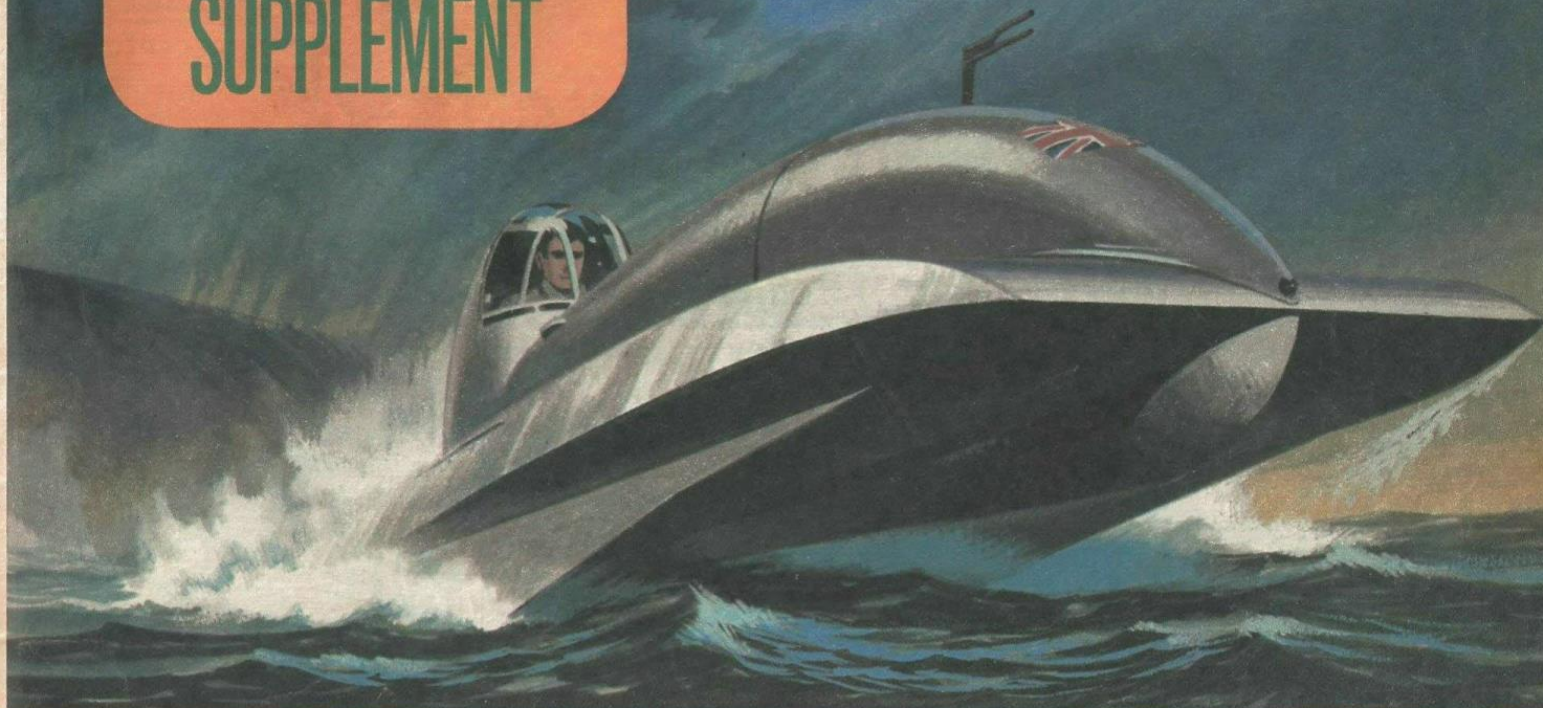
**PLANES THAT
CHANGE THEIR
SHAPE**

See page 10

LOOK AND LEARN ENTERTAINMENT SUPPLEMENT

MEN AND MACHINES

SPEED WIZARD



THE streamlined craft in the picture above could easily be a modern air-cushion vessel. But appearances are deceptive and it will no doubt surprise you to learn that it was designed in the middle of the 1930s.

This boat, named "Empire Day", sprang from the ideas of two men. One was an engineer named Edward Spurr and the other was T. E. Lawrence. This was the legendary Lawrence of Arabia who, in addition to his genius as a desert fighter, archaeologist and writer was, towards the end of his life, a master mariner and a brilliant, far-seeing

designer of marine craft.

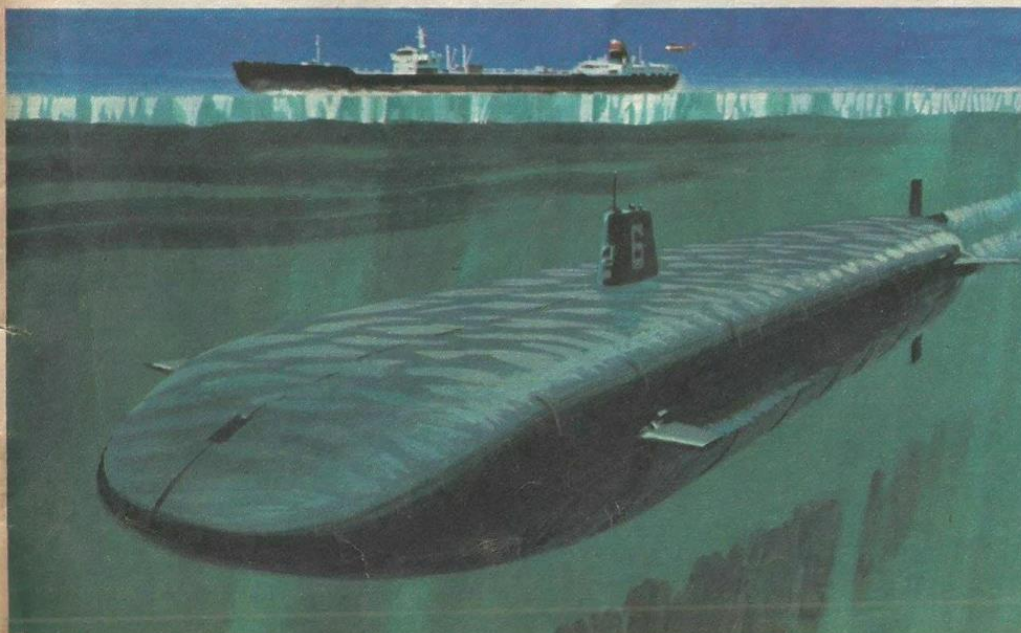
Some years after the First World War, Lawrence entered the Royal Air Force as "Aircraftman Shaw", and in 1929 he was posted to the Flying Boat Base at Plymouth.

Once there, he rapidly became expert at the handling of high-speed launches. Later, he began work with the British Power Boat Company and worked out plans and engineering details, besides making long and arduous trips at sea to test or deliver new boats.

He was already thinking of revolutionary ways to improve the speed and handling of

military boats and, in collaboration with Edward Spurr, he produced some designs which bear an extraordinary resemblance to modern, high-speed projects.

One of these was the "Empire Day", which was built and tested three years after Lawrence's death in 1935. This little boat, 16 ft. long, was made of aluminium alloy with a steel underhull. In operation, the wing-shaped outriggers at the bow lifted the hull clear of the water. Later, when it was fitted with a more powerful engine, it was said to be capable of 150 miles an hour.



SUBMARINE TANKER

A NOVEL way of carrying oil from the frozen wastes of Alaska, where rigs are now being built, has been suggested by an American company. They have completed the design for a 170,000-ton nuclear-powered submarine tanker.

Each submarine would be 900 ft. long, 140 ft. across the beam, have a hull depth of 85 ft. and twin screws giving 18 knots.

After examining the costs very carefully, the builders feel that these submarines would offer a practical and economical way of moving Arctic oil southwards.

However, the oilmen, who face the task of moving the oil from their drilling rigs at Prudhoe Bay, at present favour pipelines and ice-breaking surface tanker ships. Submarine tankers, nevertheless, are being considered but it is not likely that the first one will be ordered for at least three years.

LOOK LEARN **40** PAGES

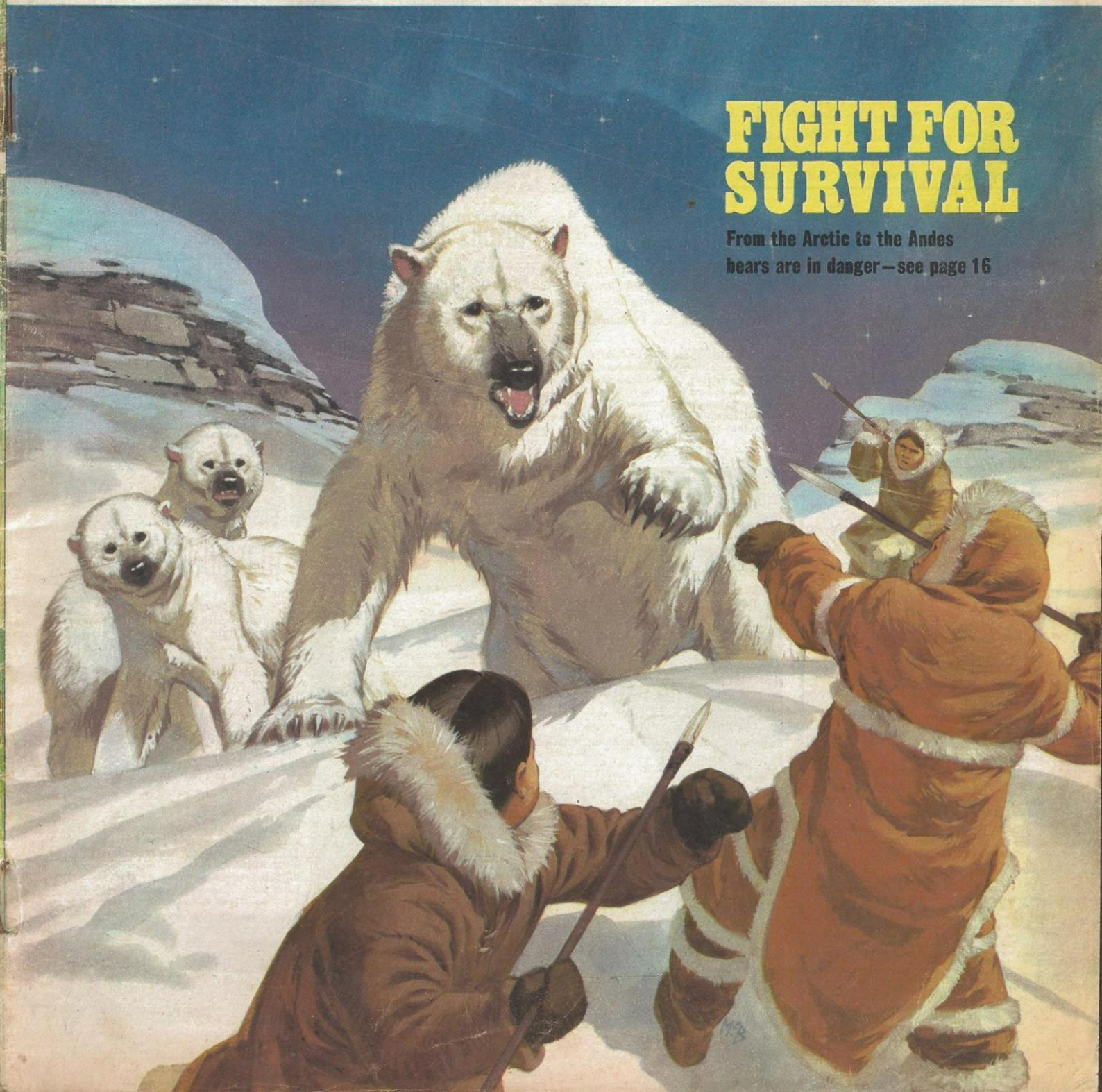
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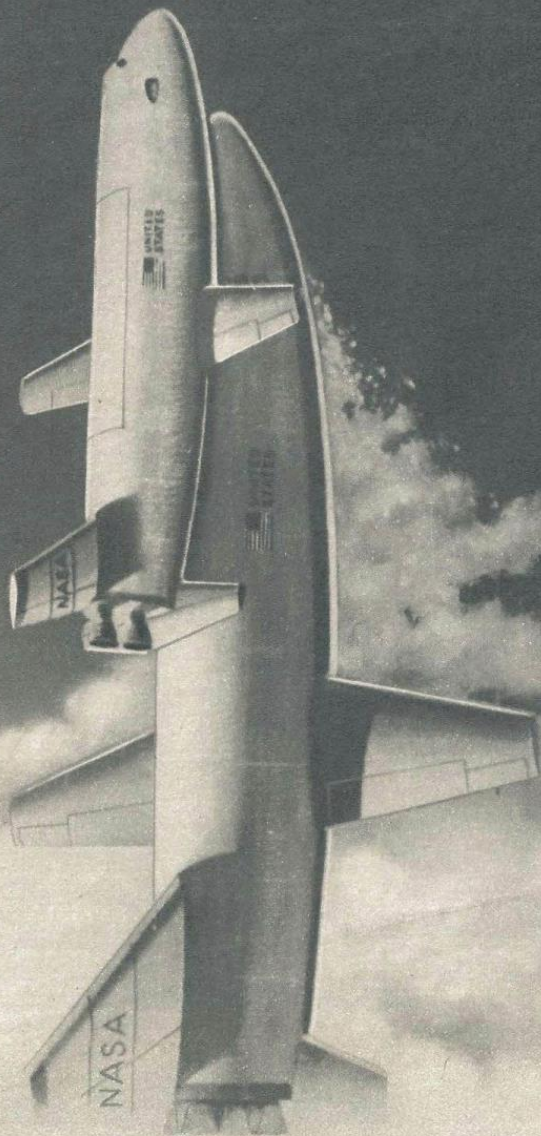
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FIGHT FOR SURVIVAL

From the Arctic to the Andes
bears are in danger—see page 16





LOOKING INTO SCIENCE



This week we look at some new ideas in space
—and on the earth

A BUS RIDE IN SPACE

THE day that anyone can book a flight to the moon or take a jaunt round the earth in a space craft is still a long way off. But it is getting closer. The forerunner of a craft to make such a trip possible is already on the drawing boards in the United States.

The craft is the space shuttle shown on the left. Scientists are confident that with it they are taking the first steps towards the aerospace liner of the future. Such a space liner would fly families into orbit to see sights that are the privilege of a handful of highly-trained astronauts today.

Several sizes and shapes of space shuttle are being considered, but it will very likely resemble a combination of rocket and plane with some qualities of each. It will be used over and over again to ferry passengers back and forth between the surface of the earth and an orbiting space station.

One group of designers is working on the design of a space shuttle which will be re-usable, chemically-fuelled and able to carry passengers from the surface of the earth into low orbit and back again.

This two-stage vehicle's lower stage would be the size of a 747 Superjet. It would be launched as a rocket booster and would lift the freight- or passenger-carrying upper stage out of the atmosphere. At that point, the booster would release the upper stage and return to earth. The upper stage, large enough to carry 50 passengers, would continue into orbit and would return afterwards to earth and land at an airport.



On the right is another look into the future . . . a "space tug" which will ferry men to the moon from a moon orbiting station by, it is hoped, the late 1970s. The Americans who designed it say that it would be able to carry nearly six tons of cargo with enough food, water and air supply to enable its three-man crew to stay on the moon for a month. In the picture, equipment is being lowered by pulleys from a hatch by space men.

THE SILENT COACH!

Air pollution in Munich, Germany, will be less with the use of the electric bus on the right. This bus makes no noise and gets its power from a block of batteries which are in a special trailer. They work for about two hours and are recharged in seven minutes. If this bus is successful, all of Munich's motor buses will be replaced by electric ones, at least in time for the Olympic Games in 1972. With air pollution an ever-growing problem, the use of electric vehicles is also being studied in Britain. Small runabout cars for use in towns have been made, but they need to carry heavy batteries.





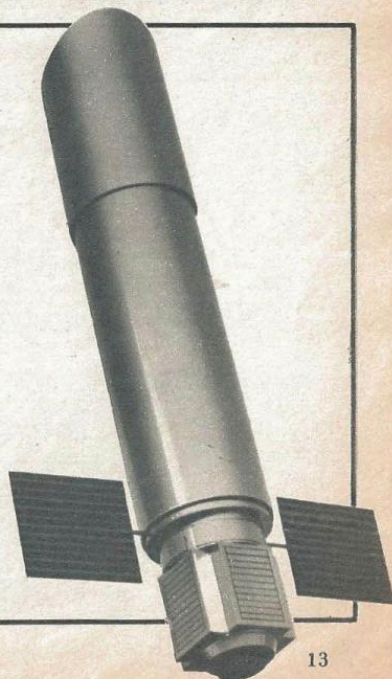
CRAWLER TRACTOR

This weird four-track crawler tractor can creep in any direction with turning or steering action. A full-sized version of this British design would be excellent for trucks which carry goods along narrow passages in a warehouse. Because they have remote control, the trucks could carry materials which are radio-active, explosive or otherwise dangerous. Several such tractors could shift heavy machinery with great care, or manoeuvre aircraft in a hanger or on the airport tarmac. This remarkable machine has two pairs of identical tracks that flank the four sides of a square chassis. Each track shoe also has small rollers set in a cross-wise direction.



EYE IN THE SKY!

American scientists are working on the idea of thrusting a giant telescope in an orbit some 300 miles above earth. Designed to last for five to eight years, the telescope would be 20 inches in diameter. It would be so powerful that it could detect the indentations on a golf ball at a distance of 217,000 miles. Called the National Space Observatory, it would send television pictures to a space station which would transmit them to earth. This "eye in the sky" idea is valuable for space exploration because the earth's atmosphere effects the clarity of telescopes on earth. With this orbiting telescope, scientists will be able to study the distant planets clearly.



LOOK AND LEARN 40 PAGES

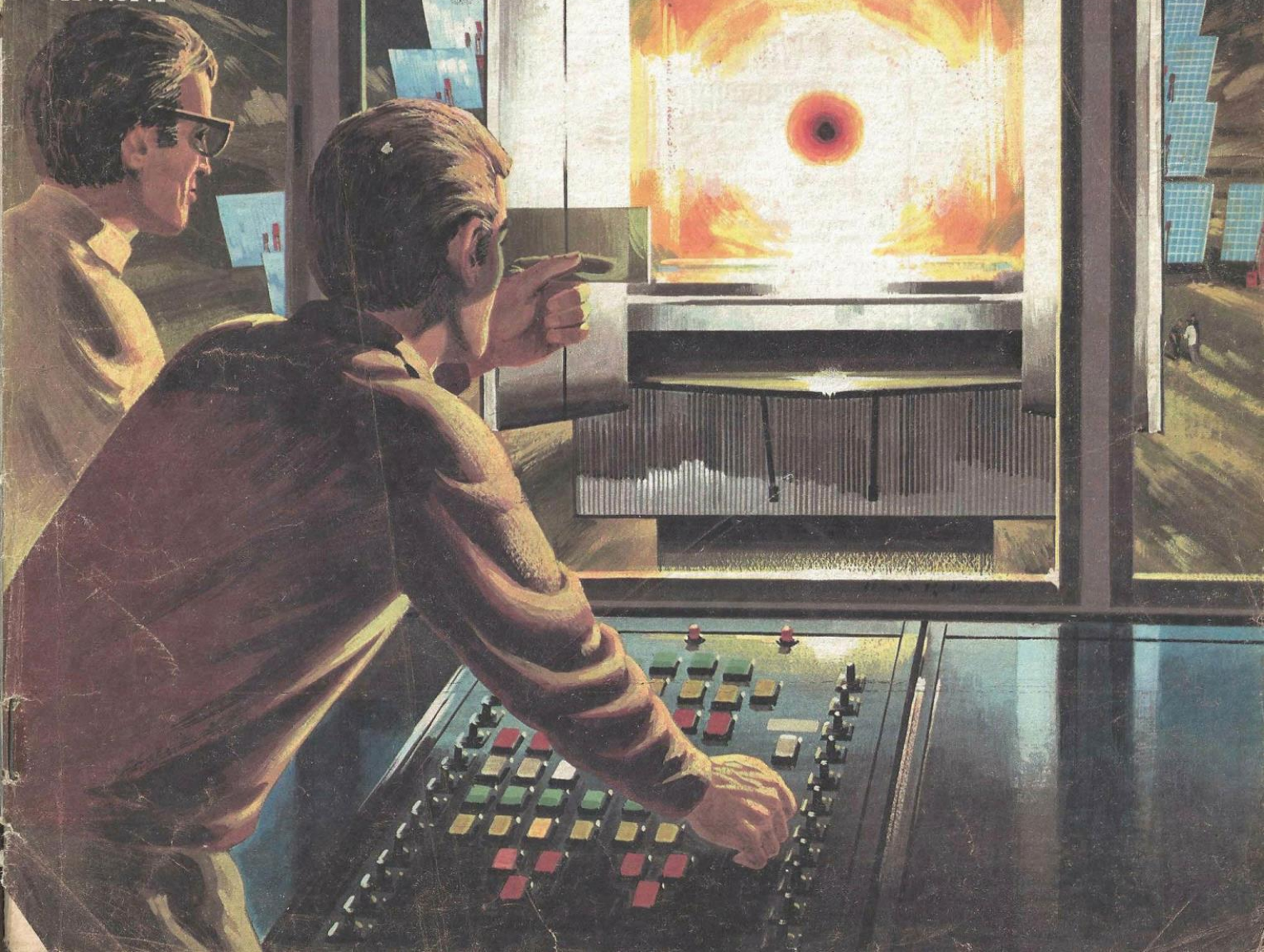
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PUTTING THE SUN TO WORK

SEE PAGE 12



LOOKING
INTO
SCIENCE



PUTTING THE SUN TO WORK



In a mountain meadow in the Western Pyrenees, French engineers have built an astonishing furnace which creates a terrific heat from the rays of the sun.

Here, an eight-storey building is faced with a curved mirror made up of 9,000 individual mirrors. In front of this are eight terraces each lined with mirrored screens 18 ft. by 23 ft., with over 11,000 mirrors attached.

As the sun shines on the mirrors on the terrace, it is reflected on to the huge parabolic mirrored surface of the building and concentrated on to the mouth of a furnace which stands before it.

This furnace is not much larger than a railway signal box, but the heat inside it becomes so great that powdered bauxite (a mineral from which aluminium is obtained) is reduced to brittle crumbs.

Heat of up to 6,000 degrees Fahrenheit can be raised within it and the solar energy it uses is equal to 1,000 kW of electricity. During some 2,000 hours of sunshine each year, the furnace can operate noiselessly, and the expensive fuel usually required for furnaces is not needed. It is marked by the absence of noisy blasting fires, smoky chimneys, trains bringing fuel and the usual soot and dirt associated with industrial plant.

Nothing could be cleaner than sunlight, and there are on the average 200 sunny days a year in the Pyrenees just 5,000 ft. below the village of Font Romeu, where the French Olympic ski teams train.

As sunlight also provides fast heat, the furnace produces within seconds heat which ordinary furnaces would take hours or even days to create.

The mirrors on the terraces are controlled by photo-electric cells which ensure that they follow the course of the sun and accurately reflect it. While there is a cloudless sky, the furnace can be operated and during the first few months of its trials it was used for experiments for French industry and the space programme.

FAST COOLING

Supervising engineers sitting in chairs a few yards away from the furnace can control the operations. This is valuable because it is impossible to watch the heart of a conventional furnace which, in any case, could not be installed in the open air.

If operations have to be halted, they are stopped by closing a shutter which cuts out the intense reflection from the sun. After this, the furnace cools so rapidly

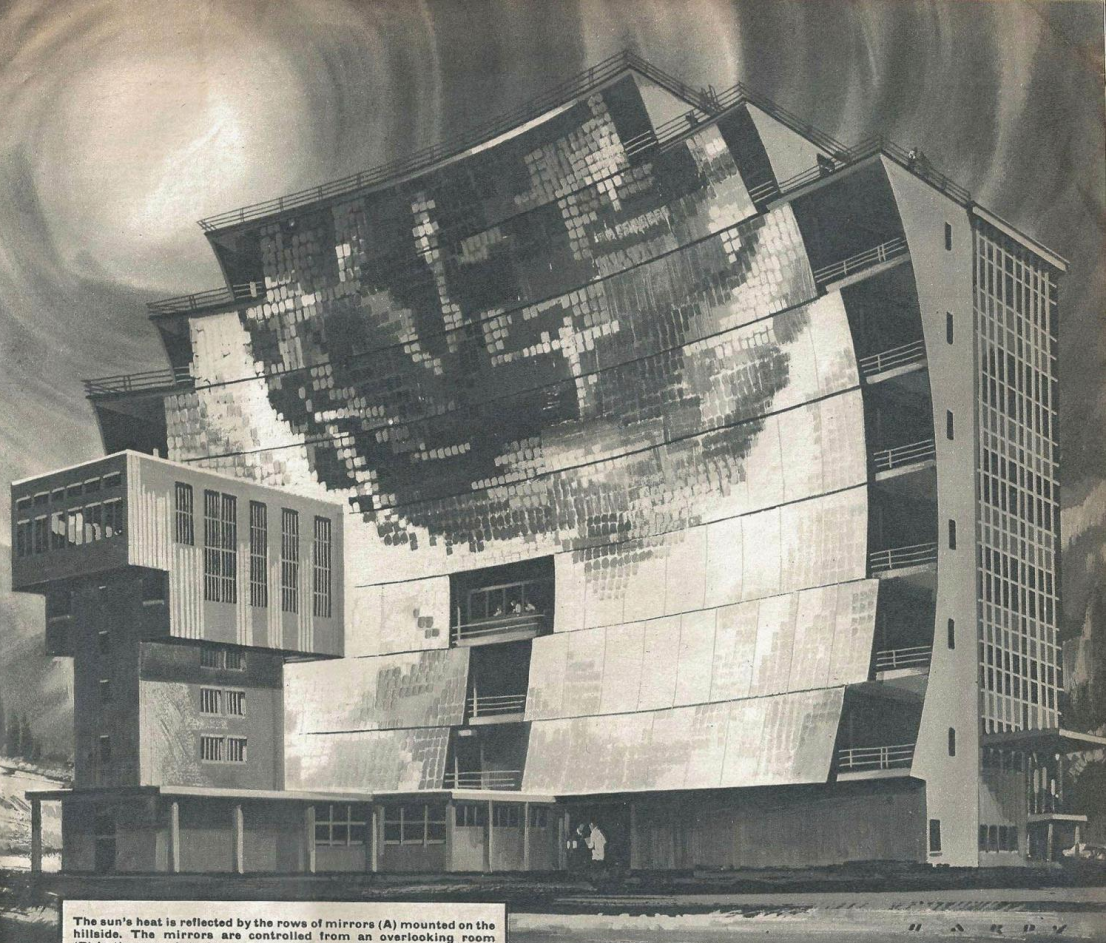
that it is possible to walk into it after ten minutes when it is no warmer than a house with central heating.

Although it cost £8 million to build, the furnace is economical to operate because its fuel is free. For this reason, it could be used in Africa or even, some experts feel, on the moon.

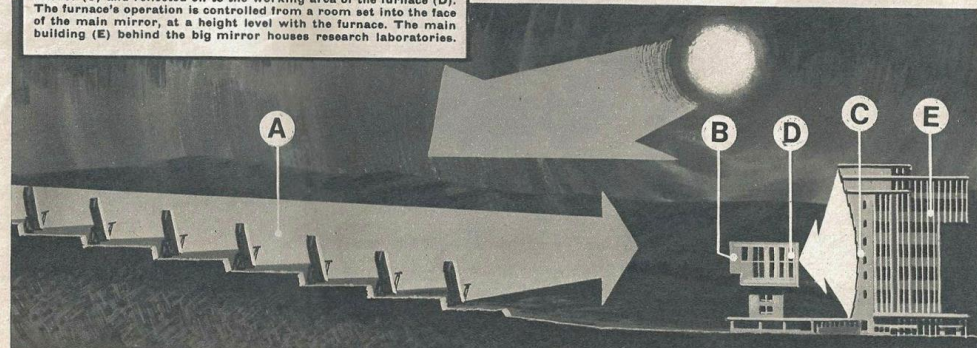
Experiments with the furnace are being carried out by a staff of 100 people who are exploring the potentialities of this scientific achievement which was designed by Professor Felix Trombe, director of the Solar Energy Laboratory of the French National Scientific Research Centre.

Thus, heat from about 93 million miles away is being put to industrial use, something which scientists have been trying to do for over 50 years. In that time, more than 30 different types of furnaces have been tried out.

One of the most successful was made by Russian scientists on the plains of Ararat. Their solar power station consisted of a huge flat-sided boiler mounted on a tower. Surrounding the tower were 20 railway tracks and on each track was an electric locomotive. These hauled wagons on which were mounted enormous mirrors which concentrated the sun's rays on to the furnace.



The sun's heat is reflected by the rows of mirrors (A) mounted on the hillside. The mirrors are controlled from an overlooking room (B) in the rear of the furnace building. The reflected heat is concentrated into a narrow, accurate beam by the huge concave main mirror (C) and reflected on to the working area of the furnace (D). The furnace's operation is controlled from a room set into the face of the main mirror, at a height level with the furnace. The main building (E) behind the big mirror houses research laboratories.



LOOK LEARN **40** PAGES

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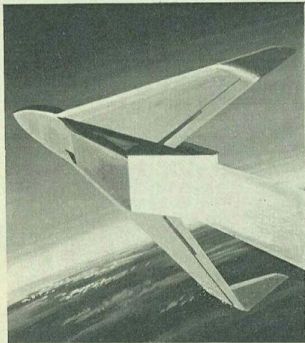
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INSIDE—**

An exciting new
series ...

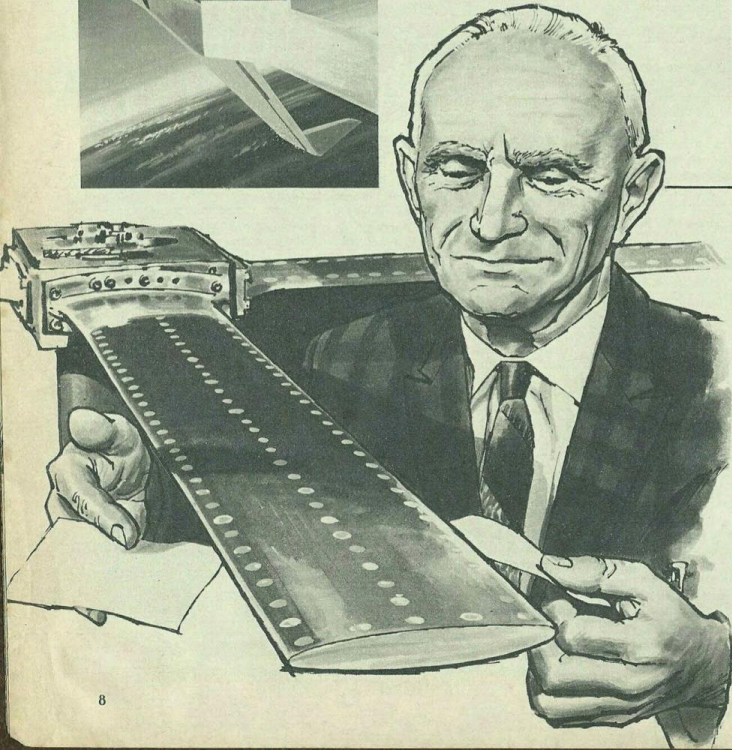
**FLYING INTO THE
FUTURE** SEE PAGE 8



FLYING INTO THE FUTURE



Two visions of the future! Left: a projected design for a hypersonic airliner capable of sub-orbital flight around the world. Such vehicles would fly at between five and ten times the speed of sound. Below: an American engineer shows the paper-thin jet slots in an experimental rotor blade being studied for possible use in 1,000 mph helicopter designs. After take-off, the rotors fold into a single, fixed wing for jet propulsion.



MODERN transport aircraft have progressed at a fantastic rate. Fifty years ago, civil transports flew at only 100 mph.

Today, they fly at 600 mph and military aircraft reach speeds of up to 1,800 mph or more. This has been made possible, to a large extent, by the development of a new type of power plant—the turbo-jet engine.

Even this may be out of date 30 years from now when rocket propulsion takes over. However, the day that families orbit the earth is a long way off. But it has become closer with the design of a shuttle craft which may become the first aerospace liner.

The American Boeing Company which has designed it sees it as a pick-a-back arrangement of a jet plane launched into space on the back of a rocket.

The carrying stage would be the size of a 747 Superjet. It would be launched as a rocket booster and would lift the passenger-carrying or freight-carrying stage out of the atmosphere. You

can see this method in the pictures at the top of the facing page.

Once out of the earth's atmosphere, the carrying stage (or booster) would shrug itself clear of the passenger stage and return to earth.

The upper stage with its 50 passengers would continue in orbit, giving the travellers an astronaut's eye-view of the world.

After this, it would return to an airport landing. "We expect the first shuttle to fly into space and back after a shorter development period than we took on the Saturn 5 space booster," said an American expert. "Thereafter, I would expect regularly scheduled flights during the remainder of the next decade."

It is possible, he feels, that within 15 years, normally healthy men and women will fly into orbit and back again with greater ease and frequency than do today's trained and superbly conditioned astronauts.

The space shuttle promises to be a vast improvement over man's present modes of space travel. Today's one-shot boosters are very expensive. They must be launched over water to avoid the danger of spent casings falling on populated areas. And they are very limited in contrast to aeroplanes.

Startling plan

The services of hundreds of men and machines are required for launching and recovering the space craft crews. In short, despite their incredible performance, today's boosters and space craft have much room for improvement.

America is also planning a supersonic helicopter capable of flying at 1,000 mph and flights in this may be possible in the 1980s.

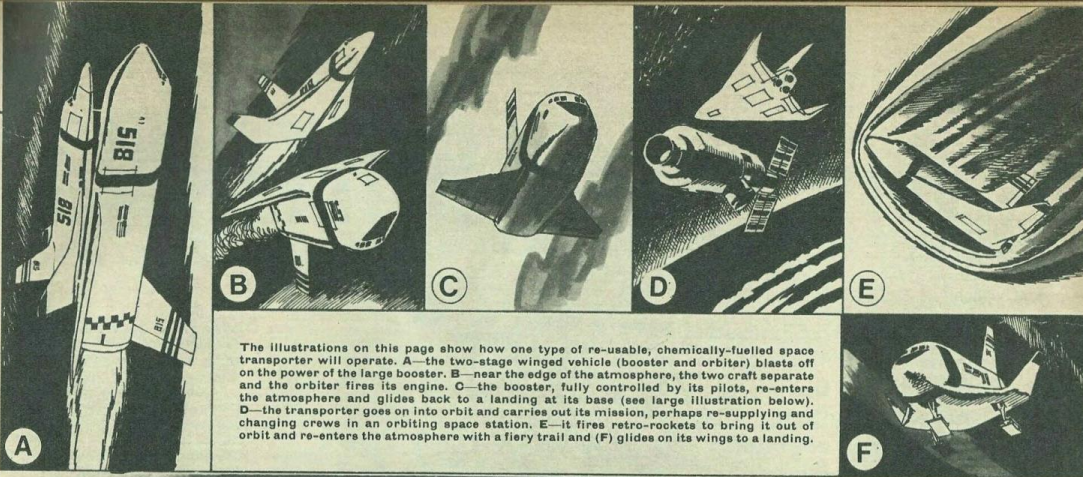
Even before this, another startling development is planned. This is a space station which may be in orbit by the end of 1972. It will be manned by three astronauts who will stay in space for about a month, before returning to earth in a space capsule.

It is thought that by the 1980s, these orbiting stations will be able to hold 50 men. Among other things, they will have gymnasiums in which the crew can keep fit.

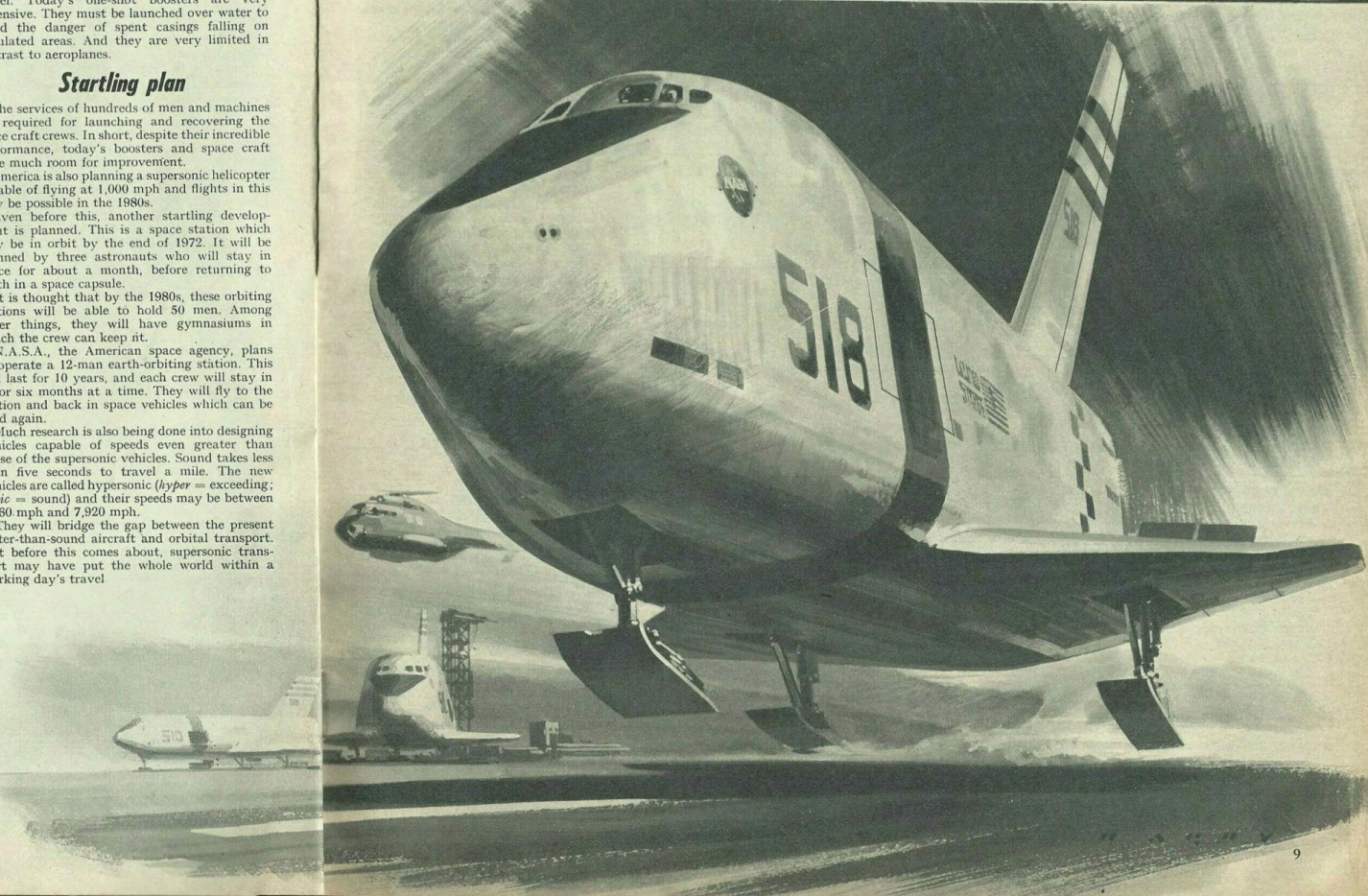
N.A.S.A., the American space agency, plans to operate a 12-man earth-orbiting station. This will last for 10 years, and each crew will stay in it for six months at a time. They will fly to the station and back in space vehicles which can be used again.

Much research is also being done into designing vehicles capable of speeds even greater than those of the supersonic vehicles. Sound takes less than five seconds to travel a mile. The new vehicles are called hypersonic (*hyper* = exceeding; *sonic* = sound) and their speeds may be between 3,950 mph and 7,920 mph.

They will bridge the gap between the present faster-than-sound aircraft and orbital transport. But before this comes about, supersonic transport may have put the whole world within a working day's travel.



The illustrations on this page show how one type of re-usable, chemically-fuelled space transporter will operate. A—the two-stage winged vehicle (booster and orbiter) blasts off on the power of the large booster. B—near the edge of the atmosphere, the two craft separate and the orbiter fires its engine. C—the booster, fully controlled by its pilots, re-enters the atmosphere and glides back to a landing at its base (see large illustration below). D—the transporter goes into orbit and carries out its mission, perhaps re-supplying and changing crews in an orbiting space station. E—it fires retro-rockets to bring it out of orbit and re-enters the atmosphere with a fiery trail and (F) glides on its wings to a landing.



LOOK **AND** LEARN 40 PAGES

No. 445, 25th JULY, 1970

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THE DEVIL'S BREW!

SEE INSIDE



FLYING INTO THE FUTURE

A series which explores the wonders of modern aviation

by PETER DUNCAN



SPEEDING GIANTS!

THROUGHOUT the world, international airports are reaching the limit of the number of planes and passengers they can handle. In New York, at peak times, delays of up to three hours are not unusual at both take-off and landing.

By 1980, Sydney is likely to be only ten hours away from London. The growth of air transport will bring air travel within the reach of many more millions of people. In the next ten years, it is estimated that passengers on the world's scheduled airlines could reach 1,000 million in a year. In Britain alone, vast increases in the number of passengers are forecast—by 1980 the flying population will be over 53 million a year, almost equal to our total population.

Speeds will double to more than 1,300 m.p.h. Today, normal cruising speeds are around 600 m.p.h.—the world's air speed record of 1949. It is quite clear that commercial aviation's most serious problem today is the continuous increase in air traffic.

If this problem is not solved, costs will soar, the advantage of speed in the air will be lost, and, worst of all, air safety is likely to be prejudiced.

How will these problems be solved?

The six largest traffic centres in the world—Chicago, New York, Miami, Los Angeles, San Francisco and London—will eventually each require probably four major airports (each with four main runways) grouped around it to meet the requirements of the future. These multiple-airports would be placed so that nobody would have to travel too far to get to the nearest airport.

With such a pattern, each of these major airports would be able to accommodate, without delays or congestion, approximately one million

aircraft movements a year. That means, perhaps, that they would handle 40 million passengers a year as a normal operation. So, four airports would together provide a comfortable capacity for four million aircraft movements a year and 160 million passengers a year.

It is intended that no airport should be more than thirty-five miles from a city centre. Surface journey times much in excess of forty-five minutes to and from airports will not be acceptable in the supersonic era. An international airport handling 75 million passengers a year would need colossal road transport facilities, and it has been established that even with a city centre-airport transit system carrying 50 per cent of the air passengers, the peak flow of road vehicles taking air travellers and airport employees to and from the airport might be 11,000 an hour. This volume of traffic would make it necessary to build 10-lane roads in each direction. From

this it can be seen that for people who live anywhere near a proposed new airport site, a major upheaval would be inevitable.

London's third airport has still to be chosen. The delay has been caused by opposition by communities to the siting of the airport—destruction of beautiful scenery and farmland, as well as perhaps the biggest problem of all, aircraft noise. As a new airport costs something like £100 million, many people believe that this money would be better spent on reclaiming land for a remote site such as Foulness Island, but others argue that it would be better spent on designing new engines or soundproofing existing ones.

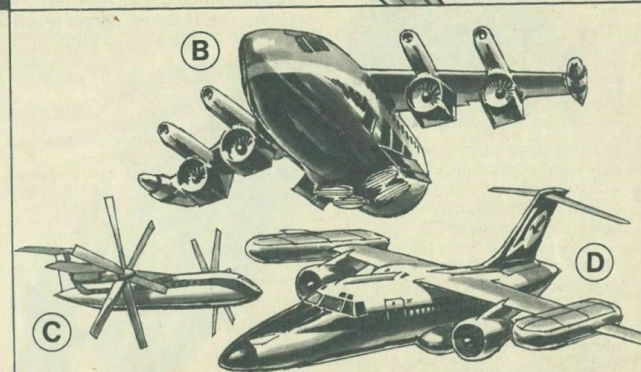
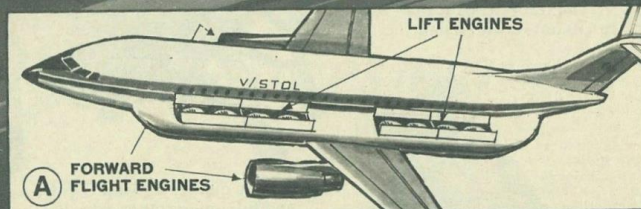
British European Airways, the biggest user of London's Heathrow Airport, say that a third London airport will not be necessary for another fifteen years. New developments in S.T.O.L.—Short Take-off and Landing aircraft—could be introduced in Britain within five years. British aircraft manufacturers think that vertical and short take-off planes carrying 100 to 200 passengers could be servicing routes of up to 500 miles by 1979.

Plans for a 120-seater jet airliner that will take-off vertically and fly at 600 m.p.h. have been announced by British Hawker-Siddeley. The H.S. 141 could enter service in the 1980s. It will have a range of 500 miles, or, if used for short take-off, it would have a range of 1,350 miles and only need a 1,000-foot runway. Government experts predict that vertical take-off aircraft could carry 16 million passengers a year, using only a small corner of Heathrow Airport. All these various arguments have to be considered, and a decision for the international airports of the 1980s must be reached quickly.

The British Airports Authority has an unenviable task, but their chairman says, "I look forward to the day when it will be possible to travel comfortably from any place on earth to any other in the space of a couple of hours—of which half will, inevitably, be taken up in getting to and from the airports or launching pads.

"I look forward to the day when all aircraft are 'whispering giants' of quietness.

"And I look forward to the day when—in the fullness of time—'the air faring outlook' is as widespread and as welcome as was the sea faring outlook in days gone by. The one made our nation great in former times. I'm sure that the other can maintain that greatness in the years ahead."



Are these the airliners of the 1980s? All these projects are V/STOL designs (Vertical/Short Take-off and Landing). At the top is shown the superbly graceful Hawker Siddeley HS. 141 (A). Its propulsion system comprises up to 16 Rolls-Royce lift fans in two jutting side sponsons with hinged air intake doors and two powerful podded underwing engines to be based on the RB 211 engine design. The lift engines give a short, steep take-off and landing while the conventional engines give high speed forward flight. At (B) is the German Messerschmitt-Boelkow-Blohm consortium's HFB-600 Vertibus. It uses four turbojets in slim pods to spin large fans. The fans' thrust (from the rear of their box-like nacelles) is directed by guide vanes to give V/STOL or horizontal flight. The Westland WG 22 "litt wing" design (C) uses two huge six-blade rotors. The Dornier DO 231 (D) uses separate lift and forward thrust engines. Twelve Rolls-Royce RB 202 lift engines are mounted in long wing-pods.

An all-too familiar scene at many of America's congested big airports . . . a queue of big jets awaiting their turn for clearance to turn on to the runway for take-off.



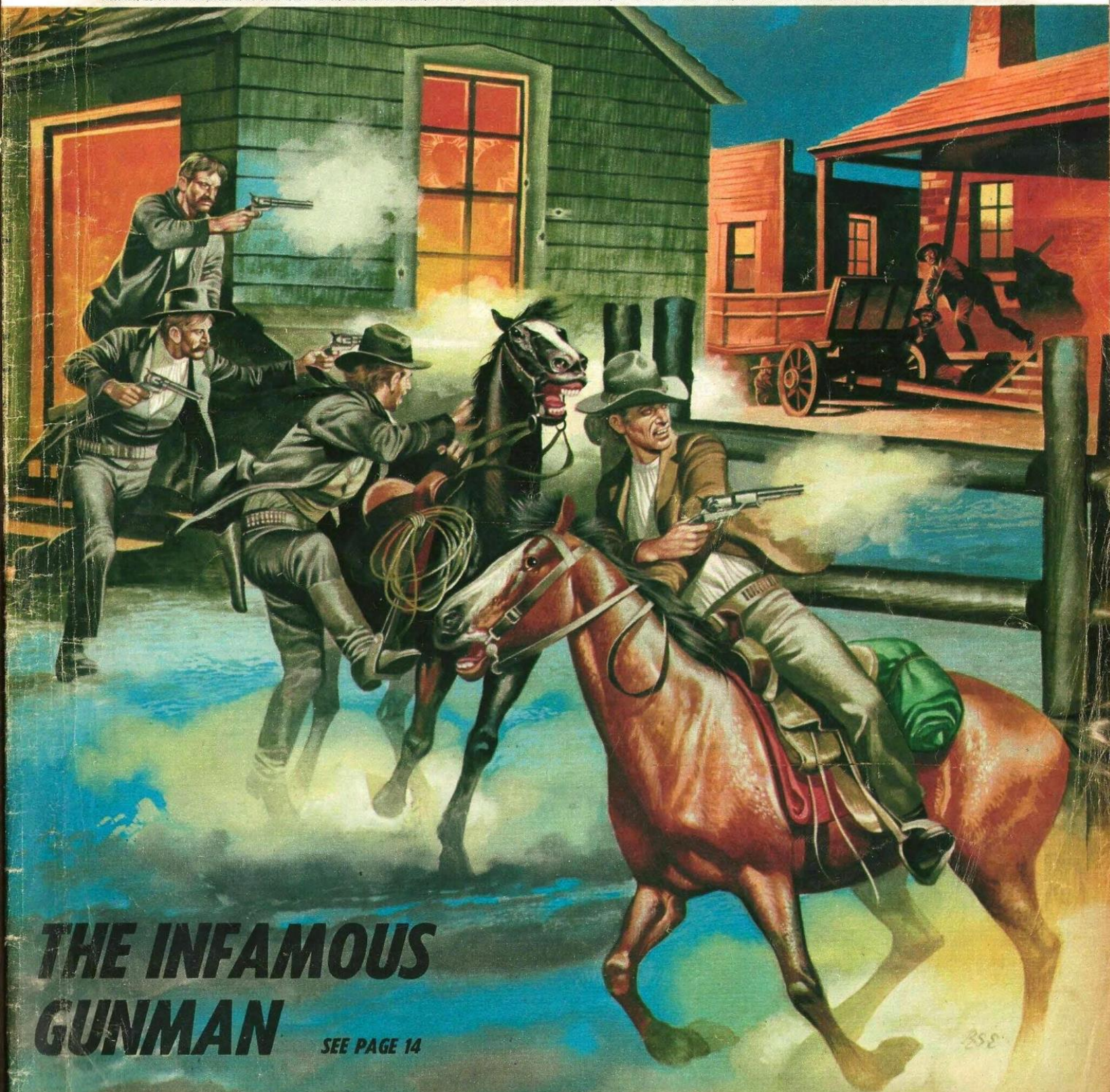
LOOK LEARN

40
PAGES

No. 457, 17th OCTOBER, 1970

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THE INFAMOUS GUNMAN

SEE PAGE 14



Shapes and colours in the sky, motionless or moving at 10,000 m.p.h. Are they strange visitors—and if so—from where?

LOOK OUT FOR U.F.O.S!

ALTHOUGH they are no longer splashed across the headlines of national newspapers, reports of U.F.O.'s, unidentified flying objects, are still being reported in a steady stream to interested organisations. As always, some of these reports can be explained away in the light of our present scientific knowledge, some can be shown to be fakes, clever or clumsy. But there is a hard core of descriptions in detail of strange sights and sounds that refuse to be explained away. These reports are from witnesses used to accurate, precise work (for example, airline pilots and radar operators) and from people not given to flights of imagination or publicity-seeking.

The year 1970 has so far given us reports of U.F.O.'s and strange visitors in England, America, Canada and Finland.

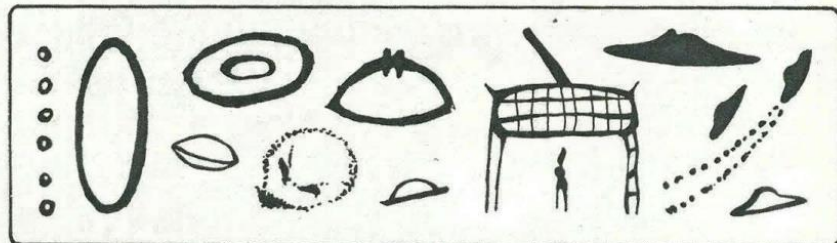
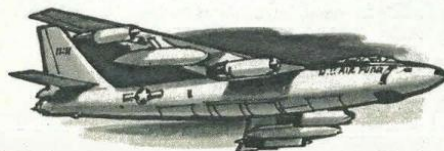
No one knows who or what U.F.O.'s are but many people are trying seriously to find out. Years of research have produced masses of detailed material, some excellent photographs and many theories. But we have no answers, except those occasional limp "official" explanations sweeping the whole subject under the carpet.



Lakenheath and the Gulf Coast

were the locations of just two of many U.F.O. incidents that have involved highly-trained aircrews and ground radar operators—and are still unexplained. Over East Anglia, on the night of 13th-14th August, 1956, blips appeared on the radar screens of ground control approach at Bentwaters Air Force base where the astonished operator first estimated their speed as 4,000 mph. Later estimates put the speed at 6,000-9,000 mph. The radar groups at Lakenheath were alerted and they, too, picked up the objects. In the classic U.F.O. manner, they manoeuvred with ease at incredible speed and stopped abruptly. An R.A.F. De Havilland Venom night fighter was scrambled from R.A.F. Waterbeach, 20 miles south of Lakenheath, to intercept. The pilot reported locking on to the target and then seeing it ahead with his own eyes. Suddenly, the U.F.O. vanished.

On the night of 19th-20th September, 1956, a U.S. Air Force Boeing RV-47 bomber, packed with electronic instruments, was followed by a U.F.O. for more than an hour. During that time, six highly-trained crewmen had the object clearly on their radar screens and could see it with their own eyes. No flying manoeuvres could shake it off and like the U.F.O. over Lakenheath, it vanished from sight and radar simultaneously.

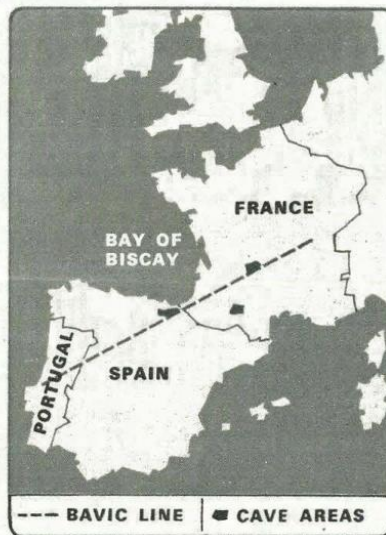


Stone Age Saucers can be found in the cave paintings and carvings of 12,000 years ago—so many researchers believe. The blaze of publicity for "Flying Saucers" came mainly in the fifteen years after World War II but man's records for thousands of years into the past show that the U.F.O. may have been with us all the time.

The strange shapes shown above have been faithfully reproduced from the famous cave paintings and carvings found in southern France and the Cantabrian area of northern Spain. (They are from the works of a Frenchman named A. Leroi-Gourhan.)

"But they could represent anything," is a natural reply to such a statement until one compares them with the beautiful accuracy of the cave artist's paintings of their own people and the animals they hunted. We can assume that such gifted artists painted everything as they saw it—and, therefore, that these strange saucer shapes were something they saw.

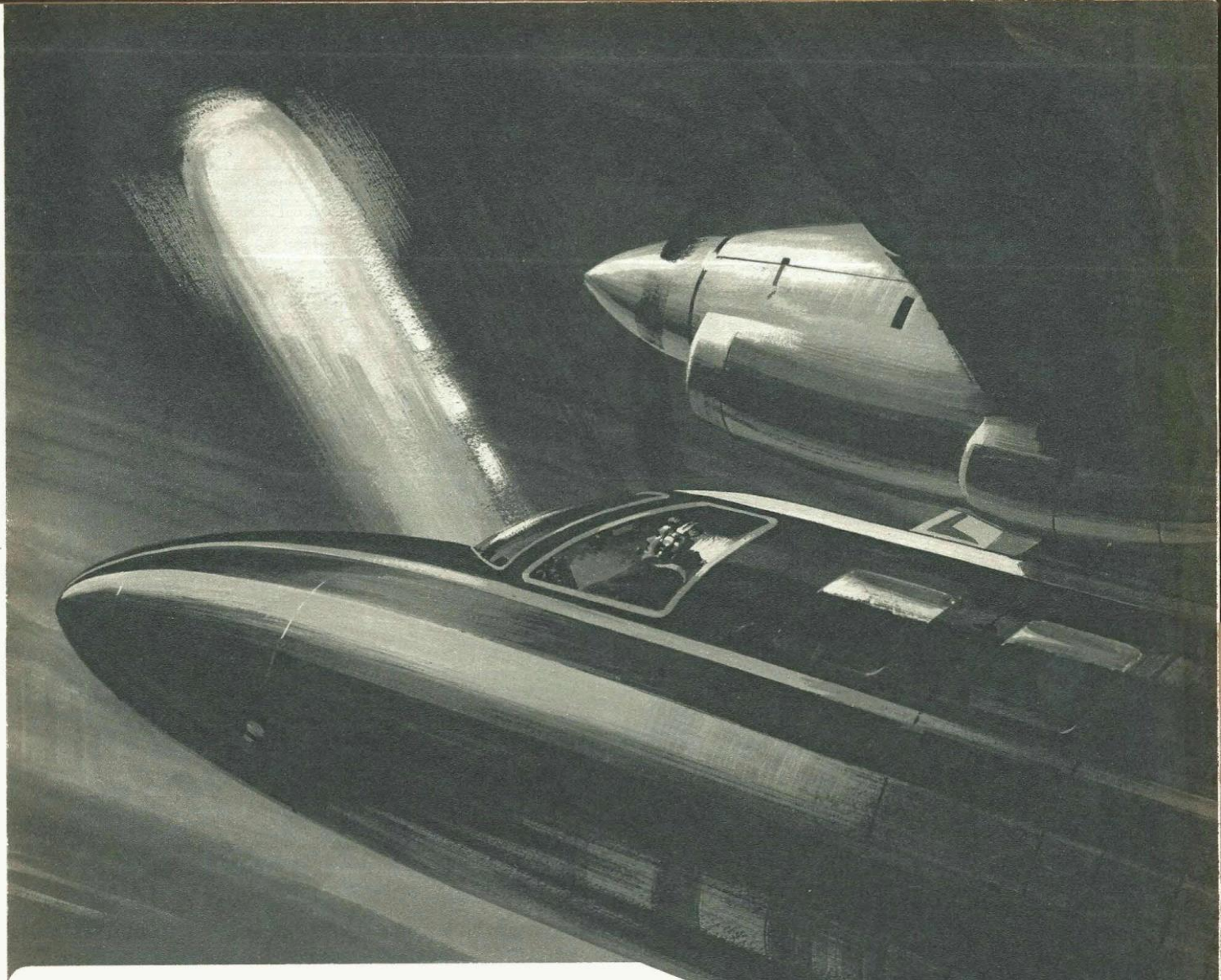
The U.F.O. continues to appear down the ages. At Byland in Yorkshire in the year A.D. 1290, the brethren of a monastery were visited by a round, flat, silvery object like a discus which flew low overhead and quite naturally terrified them.



The Bavic Line was discovered by the eminent Frenchman, Aimé Michel, a much-respected U.F.O. researcher. The year 1954 was a peak year for U.F.O. sightings and the experts in France were once again trying to find a pattern, an answer. One of their approaches was to plot each day's sighting on a map—all they got was a map covered in dots, until Michel suggested plotting each day separately.

The map for 24th September, 1954, showed six reliable sightings in a dead straight line from Bayonne to Vichy—hence the "Bavic" line. This was an astounding discovery. The mathematical odds against so many groups of witnesses seeing the same hallucinations, on the same day in places in a straight line spreading halfway across a country were astronomical.

Strangely, the Bavic line (since extended down into Portugal by further discovered sightings) passes directly across the areas of the caves in which the flying saucer paintings and carvings were found of 12,000 years ago. *These paintings of saucers occur only in caves on the 1954 Bavic line and nowhere else in the whole of Europe.*



"Look at that goldarned thing climb!" was shouted to a South African pilot named Anton Fitzgerald by his co-pilot, Jake Rugel, as they flew at dawn over Texas in a Mitsubishi MU-2 business plane. The "thing" was a glowing pink shape streaking upwards past them to be lost seconds later in the clouds above. Fitzgerald was not as amazed as he should have been. He quickly asked Rugel to reduce engine power and dive the plane. He already knew what would happen when they entered the airspace where the "thing" had passed—this was the second time he had seen such a U.F.O.

Sure enough, the MU-2, though throttled back and diving, suddenly shot upwards, as though weightless, 15,000 feet in a few seconds!

The first time Fitzgerald saw the pink U.F.O. was almost exactly a year before in Natal, South Africa. He was walking out at dawn with his farm manager towards the twin-engined Aero Commander which he was to fly to Durban. In the pale light they saw what appeared to be a huge bright pink bubble of gas. Near it were a flock of sheep, standing motionless as though hypnotised. As they got closer, the bubble rose up without a sound and streaked away into the overcast—and the sheep rose up with their heads and front legs in the air like ballet dancers on their toes. The two men felt themselves becoming strangely weightless. One old sheep was found to be missing.

Fitzgerald went to his plane, checked it and roared off down the runway for take-off. As he passed through the air where the pink thing had risen, the aircraft shot upwards like a rocket into the clouds! By the time things settled down, he was at 10,000 feet.

Back to Texas a year later—a rancher, who was to have met Fitzgerald and Rugel at the airfield where they landed, telephoned to ask them to come over to see him at his ranch instead.

When they landed, the rancher told them that he had been visited by the pink U.F.O. they had seen. This time, there was a hypnotised herd of Texas cattle, the same silent take-off and the feeling of weightlessness—and one old steer was missing.

Will these things ever be explained? Researchers hope so. But it looks as if the work will take a great many years. Can the U.F.O.'s be something from another planet? It would certainly be exciting if they were.

Meanwhile, it is important that any strange "things" that are seen should be reported. Only by collecting information, can any acceptable conclusion be reached!

Reeve

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No. 469, 9th JANUARY, 1971

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**WHEN THE RED
MAN RODE** SEE PAGE 19

IT HAPPENED THIS WEEK

A diary of events recalling people, places and happenings that made this week memorable in other years.

14
JAN

The great space race between the Americans and the Russians took a great step forward on 14th January, 1969, when the Russians sent Soyuz 4 into orbit. The Soyuz spacecraft consisted of a spherical laboratory and rest compartment on the nose of the re-entry capsule. Soyuz 4, piloted by Vladimir Shatalov, was orbiting the earth when Soyuz 5 was launched. In this second craft were three crewmen—Boris Volynov, Aleksei Yeliseyev and Yevgeni Khrunov. After lengthy manoeuvres, the two Soyuz capsules docked in space, and Yeliseyev and Khrunov, wearing pressurized suits, walked from Soyuz 5 to Soyuz 4. The ships then parted company. This operation is notable for being the first occasion on which two spacecraft met in orbit and exchanged passengers.



11
JAN

By the beginning of 1942 the Japanese threats to the Dutch East Indies were proving to be a very large headache to the Allies. General Wavell, Supreme Commander of A.B.D.A. Command, arrived in Batavia on the 10th January, and set up headquarters near Bandoeng. But on 11th January, 1942, the Japanese launched another successful attack on the island of Celebes, and captured the key base of Manado. Wavell sent for reinforcements; the Dutch, with their homeland in bondage, had no further resources, but eventually Australian and British forces arrived from the Middle East, and the United States Asiatic Fleet was diverted from the Philippines. Every effort was made, but this took time, and the Japanese made more great advances. In March the Dutch surrendered the islands.



10
JAN

In 1837 Sir Roland Hill's pamphlet "Post Office Reform" advocated a uniform rate of postage—a penny per ounce—prepaid by an adhesive stamp. Despite opposition a parliamentary act in 1839 brought the introduction of the penny post on 10th January, 1840.

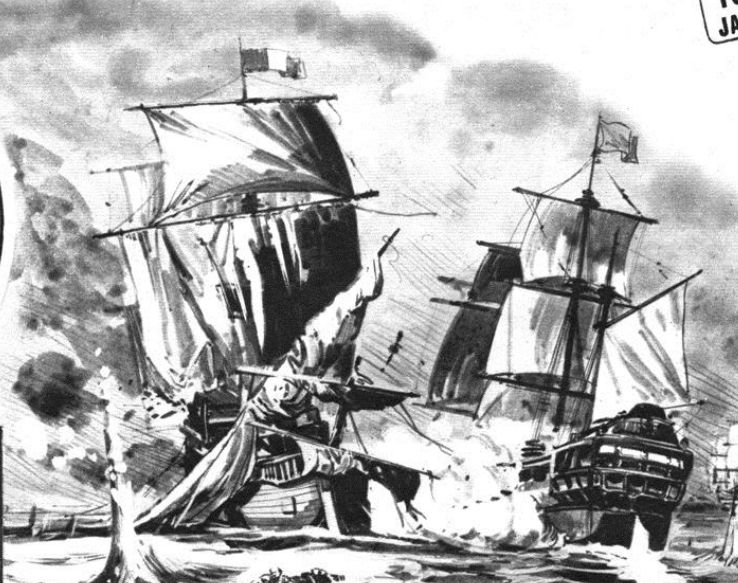
16
JAN

On 16th January, 1809, during the Peninsular War, a heavy land battle was fought between British and French armies at Corunna, in Spain. The British Commander, Sir John Moore, might have succeeded in bringing about a British victory, but unfortunately at a critical point in the battle he was hit and completely lost his left arm. Knowing his wound to be fatal, he allowed himself to be carried off the field and handed over command. This change of command lost the battle, for the new commander was indecisive, and darkness fell before either side could claim a victory. Next day the British made good their escape by sea, unmolested. But at dawn, before they left, Sir John Moore was buried on the ramparts of Corunna.



13
JAN

On this day in 1691 died George Fox, founder of the Quaker community. He and his followers were often persecuted. The word "Quaker" came about when Fox told a magistrate to "tremble at the Word of the Lord."





16
JAN

On 16th January, 1920, alcoholic drinks became unlawful in the United States. Not since slavery had an issue been so hotly debated by the American people. But the law was found impossible to enforce; spirits were smuggled in over the Canadian and Mexican borders, and the courts could not cope with the many offenders. This ban—prohibition—lasted nearly 14 years.



15
JAN

Servius Sulpicius Galba became Emperor in Rome after the death of Nero. He was welcomed by the Senate but never became at all popular with the people. He incurred the deep hatred of the praetorians by refusing to pay the rewards promised in his name and disgusted all by his meanness. On 15th January, A.D. 69, he was assassinated. He had been a good general but a bad ruler.



12
JAN

12th January, 1945, saw a massive offensive by the Russian forces in the final stages of the Second World War. Stalin's aim was to gain land from the Germans for a new and better Poland, for some of the German land was industrial. The aim for the Russian army was to advance to the Oder river. They reached this in February.



The week of 10th to 16th January holds several interesting anniversaries. On the 10th, in 1645, the Archbishop of Canterbury was beheaded. He was Archbishop Laud. And on the 10th January, 1946, the first United Nations General Assembly was held in Westminster Central Hall, London.

The 11th is a good day for politics, too. In 1790 Belgium became a united country and in 1946 Albania was declared a republic. The 12th is a day of births and deaths—Emperor Maximilian I died in 1519, and Marshall Joffre was born in 1852.

Two more deaths on the 13th! Caesar's uncle, the Roman general Gaius Marius, died in 86 B.C., and James Joyce, the writer, died in 1941. Lewis Carroll, the man who wrote *Alice in Wonderland*, died on 14th January, 1898, and on 15th January, 1759, the British Museum was opened. On 16th January, 1547, the first Russian czar was crowned—which is interesting, because if you didn't know that, you might think that Russia had had czars for as long as Britain has had kings and queens. So, you see, it was all happening. . . .

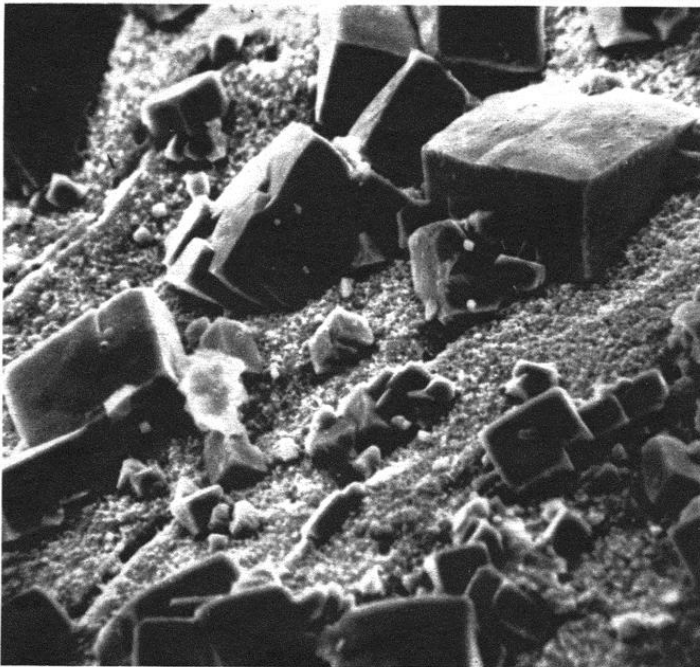
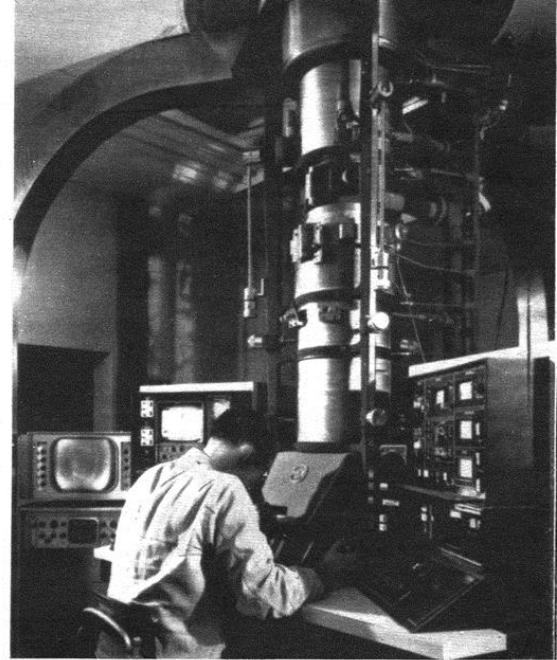
New ideas of today...

LOOKING INTO SCIENCE



ELECTRONIC ENIGMAS

Take a careful look at the pictures below and see how many you can identify. Easy? Well... look again! The picture below on the left could be craggy moon rocks photographed by Neil Armstrong, the first man on the moon. What about the picture below it? That's obviously the seared nose-cone of a space craft scorched by a fiery re-entry. And the carved head (bottom right)? Recognise it?



Are these moon rocks or something more earthly?

What a problem these pictures are! But before you try to puzzle out the objects, turn your eyes to the photograph above. That gives the game away. Yes, you have guessed correctly. It is a super microscope capable of producing a sharp image at magnifications of tens of thousands of times.

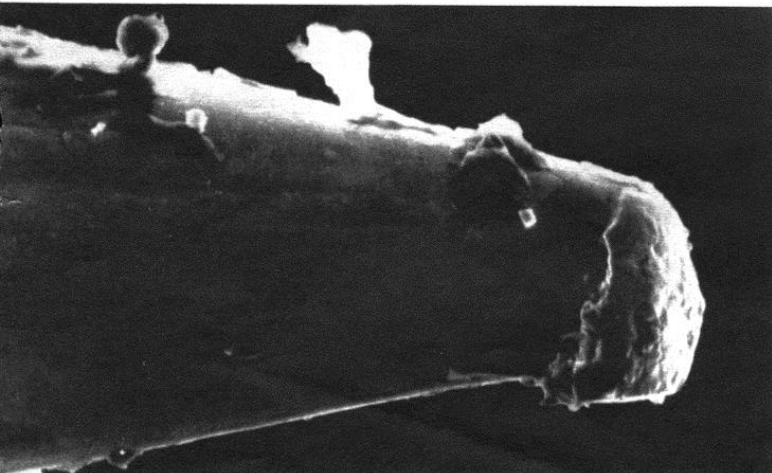
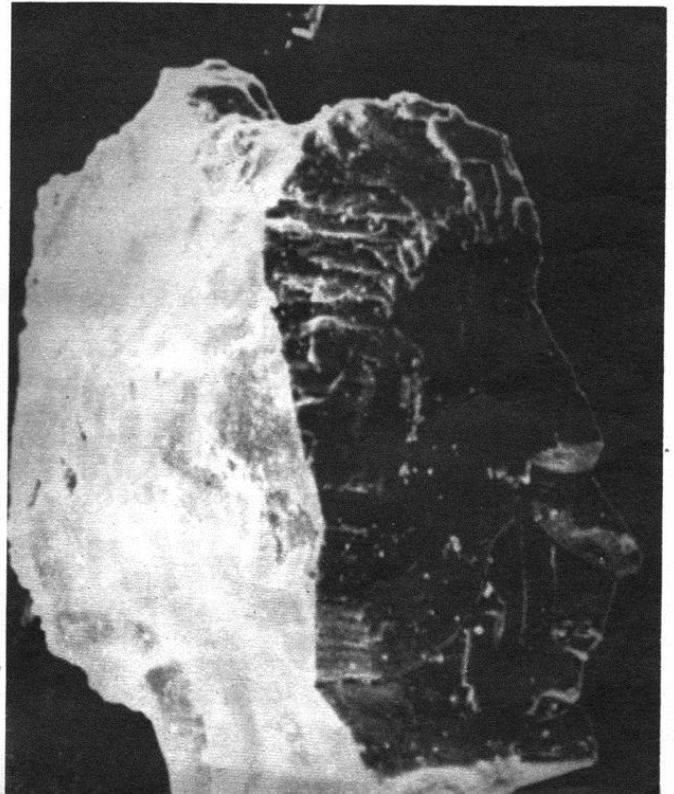
Now, let us look at the pictures again before checking on the surprising details revealed by the microscope. The picture on the left shows something all motorists dread. No, not rocks, earthly or lunar. The formidable boulders are particles of ferric oxide... rust on a steel surface. If you have begun thinking small enough, you may have guessed that the picture underneath it is really of a used sewing needle blown up 110 times by focusing rays of electrons on the subject.

The sculpture below is in fact a speck of moon dust smaller than the full stop

at the end of this sentence. It was brought back by Apollo II astronauts and magnified 700 diameters under the microscope.

This, then, is the world of the electron microscope—an instrument usually devoted to more serious research in science and technology. A scientist peering at a minute sample sees a world that is invisible to the human eye. It is a world that adds new knowledge and dimensions to scientific research. Already under development are even more advanced microscopes which will be capable of producing sharper images of the miniature world around us. Who knows what remarkable objects will be revealed with these? If you stop to consider the amazing fact that the discovery of the electron by Sir J. J. Thomson, occurred less than a hundred years ago in 1897, you will marvel at the advances made.

Don't guess *who* this is but what it is!

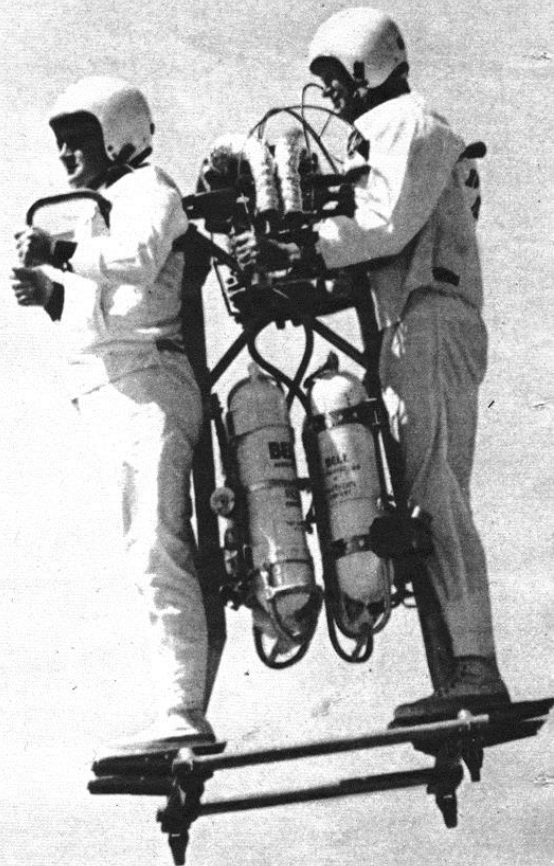
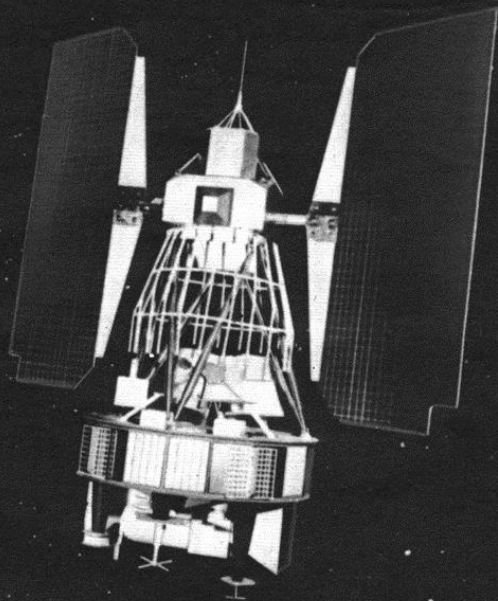


Could this be the seared nose cone of a space ship?

SPACE WATCHER

Weather satellites and other orbiting watchdogs are to be joined by a further "eye in the sky" in a year or so.

This will be launched from America with the high sounding name of Earth Resources Technology Satellite (ERTS for short). It is expected that this one-ton craft will carry instruments to measure the amount of food growing on the earth, and the fresh water, fuel, mineral and forestry resources. Forest fires may be spotted and tracked by it, and it will watch out for iceberg flows, earthquakes and swarms of locusts which eat growing crops. Two will cost about £20 million.

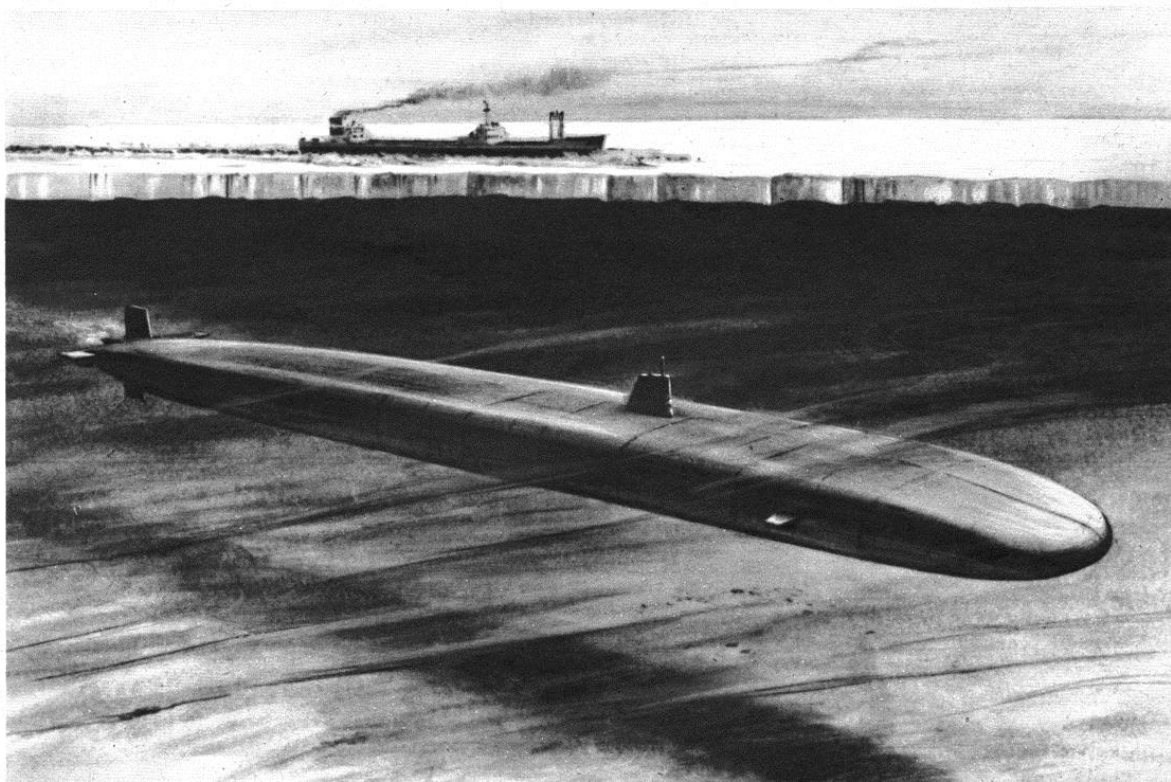


ROCKET TAXI FOR TWO

Pogo, a two-man space taxi, is here being given a test run at Niagara Falls in America. This is designed for a variety of jobs on the earth and on the moon. Stranded astronauts could be rescued by it and heavy equipment moved about.

ICE BEATER!

Deep beneath the thick ice of Alaska, in America's frozen north, lies a rich store of oil. Wells have been sunk to recover this. But how can the oil be shipped south? Perhaps the submarine tanker here will prove to be the answer. It has been designed by an American concern and offered to several oil companies. This vessel could carry as much as 170,000 tons of crude oil under the ice of the North West Passage from the Atlantic to the Pacific, or under the Arctic Ocean to the east coast of North America. From there, it could go into a pipeline.



LOOK **AND** LEARN

40
PAGES

No. 472, 30th JANUARY, 1971

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ANOTHER CHANCE FOR THE AIRSHIP? Will They Fly Again...

See Page 6



The world's largest rigid airship, the Hindenburg, was nosing gently to the mooring mast at Lakehurst, New Jersey, U.S.A. Suddenly, an engulfing fire turned her into a roaring inferno which, moments later, crashed to the ground, killing 35 of those aboard.



WILL THEY FLY AGAIN?

IN the early evening of 6th May, 1937, the world's largest airship, Hindenburg, was nosing gently to the mooring mast at Lakehurst, New Jersey, U.S.A. Suddenly, an engulfing fire turned her into a roaring inferno which, moments later, crashed to the ground, killing 35 of those aboard.

This disaster was to signal the end of a period of prolific airship construction which, between 1900 and 1940, had produced 158 rigid airships (those with an internal "skeleton"), the majority Zeppelins, and over 250 non-rigids or Blimps (inflated airships). Today, with only three or four airships, all of them Blimps, remaining in operational condition, it would appear that their extinction is not far away. In fact, the reverse is the case. Recent airship studies conducted in Russia, Germany and the United States (together with a new company here in Britain which advocates the return of the airship, Cargo Airships Ltd.) show that rapid advances during the last decade now make possible a safe and economic airship. This could help to ease some of the problems of modern life.

To appreciate how this has come about, it is important to understand the principle that keeps an airship airborne, and also to examine some of the defects of the old Zeppelins which have led people to think they were dangerous when, in fact, they were relatively successful.

There are two principles—or means—by which an aircraft may obtain lift into the air. The one by which aeroplanes, gliders and helicopters fly, is called aerodynamic or wing

lift. This is achieved, partly, by presenting a large area of resistance to the air flowing below the vehicle, in the case of a plane, or by constantly pressing upon this air, in the case of a helicopter.

The means by which balloons and airships fly is known as aerostatic or displacement lift.

An airship is able to float in air when its total weight, including that of its very light lifting gas, are equal to the weight of the volume of air it displaces. Once the lifting and descending forces have been equalised, the airship will remain buoyant regardless of any changes in temperature, air pressure or altitude. This enables it to remain airborne without engine power. Of course, when it is like this, it could easily be blown anywhere by the wind. So, engines are provided to push it through the wind and to steer it.

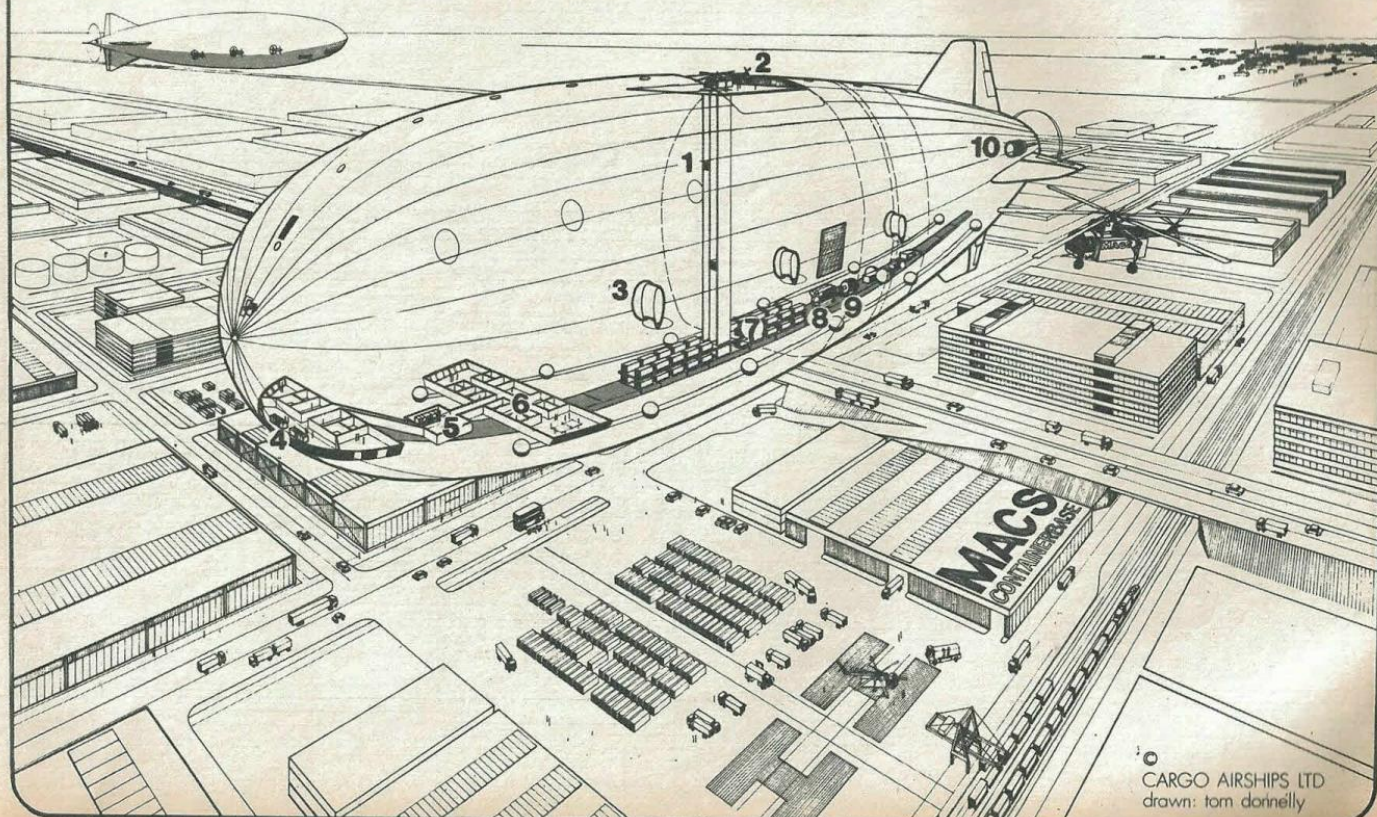
It is useful to recall the design of the old Zeppelins when considering a new breed of airship. Their end was in some part due to a number of spectacular accidents which were almost always attributable to either one of the following defects or a combination of all three:

1. Lift was achieved by using hydrogen gas which was not only flammable but, in certain cases, explosive.
2. Technology was insufficiently advanced to provide the materials and constructional techniques that were needed to realise the full potential of the airship.
3. Lacking in power, the airship allowed little margin for pilot error; once in trouble, airships

KEY TO AIRSHIP DIAGRAM

1. Cargo elevator shafts.
2. Helipad (retractable cover).
3. Manoeuvring propellers (swivelling, variable pitch).
4. Bridge.
5. Computer room.

6. Crew quarters.
7. Cargo decks.
8. Diesel engine.
9. Generator.
10. Main motor.



CARGO AIRSHIPS LTD
drawn: tom donnelly

Cargo could be carried direct from the factory to its destination by the type of modern airship described on these pages.



often had no reserve to effect a safe escape.

Today, it would be possible, with the aid of modern technology, to remedy all these problems to advantage for, despite the drawbacks of the Zeppelins, the concept of lighter-than-air craft is a sound one.

Within the hull of a modern airship would be mylar plastic cells containing safe, inert helium lifting gas. Providing 93 per cent of the lift of hydrogen, non-flammable helium is far easier to handle and control and, at the same time, removes the risk of explosion and fire. Helium, present in almost all natural gas fields, is readily available in Britain today due to the discovery of new sources, for instance under the North Sea, and to the improved extraction processes which were encouraged by the American space programme.

Better performance

Airship hulls could now be constructed far more efficiently than the labour-intensive skeletons of old. Zeppelin structures, made from millions of small aluminium components, were laboriously riveted together into girders. The girders were then formed into ring frames and then these frames were linked together longitudinally with even more girders. The resulting hull was then stressed with miles of wire cables. Not surprisingly, the end product was not only flexible but weak. In flight, the collapse of just one of those girders could herald the collapse of surrounding girders, and often the destruction of the airship.

With the introduction of composite materials of metal and plastic,

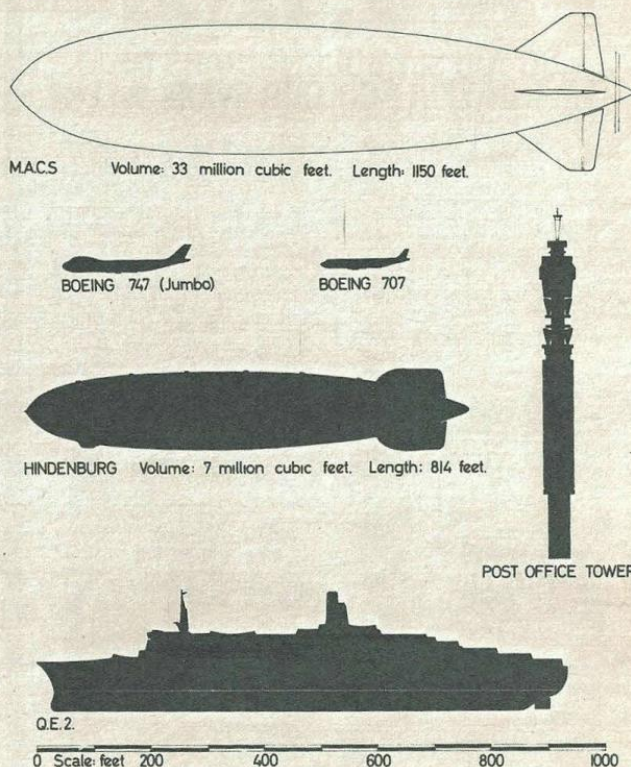
today's airship hull could be constructed in one complete structural skin. This hull, more like a shell than a framework, would be both stronger and lighter than the Zeppelin structure, due to the inclusion of such material as carbon fibre—an example which illustrates how modern technologies could improve the airship's performance to its full potential.

The development of aeroplanes over the past 20 years has led to the production of very powerful engine units with extremely efficient power-to-weight ratios. Using these engines, the airship would now have ample reserve power to get out of trouble in emergencies and, with such sophistications as hourly satellite weather reports and with a computer on board, the pilot of an airship would now have a far simpler job to perform.

If we accept, then, that it would be possible to construct and operate a better airship using today's technological skills, what could it be used for? One answer is as a cargo transporter. On inter-continental routes aeroplanes can travel quickly carrying small loads, and ships travel slowly with large loads. It is into the gap between these two that the airship fits. The aeroplane and the ship both suffer to some degree because the cargo they carry is often congested at the terminal airport or dock. On top of this, any time it may take to move the cargo from the manufacturer to the dock at one end, and from the dock to the customer at the other, must be included in the total transit time.

By being able to carry loads in excess of 500 tons, the airship illustrated here could pick up cargo directly from a factory and deliver

COMPARATIVE SIZES



CONTINUED ON NEXT PAGE



A non-rigid airship or "blimp" which carries sightseers over Florida, U.S.A.

it to the customer many thousands of miles away. Travelling at a steady cruising speed of 100 mph, 24 hours a day, it could reach New York in 36 hours and Sydney in just over five days. Moving at this slow speed, the airship would make little noise or pollution and, at the same time, by picking up directly from the manufacturer and setting down at the customer, would obviate the need for road haulage, and thus relieve some of our congested roads.

Another airship use is that currently called the "sky hook." Instead of lifting a number of small cargo units, this application proposes to use the full lift of the airship to move some very heavy single payloads. Completely prefabricated floors of housing projects can be lowered into place. But this could just as simply be a transformer in Europe or an electrical generator in North America.

Using its enormous lift and ability

to hover motionless over an area, the airship could serve humanitarian needs too. In disaster areas, after floods or earthquakes, it is not unusual to expect a disruption of the transport services. With roads washed away, runways broken up and harbours destroyed, the rescue and relief forces are often unable to reach the suffering for many days. The hovering airship could, of course, not only bring huge loads of relief in the form of food, shelter and medical supplies to such a disaster area, but would also dispense these together with the rescue crews. Then it could fly out the disaster victims.

This is only a beginning. As the airship revival gains strength, its followers, once called cranks and now enthusiasts, reflect that successful inventions usually go through three stages. At first they are laughed at, then feared and then accepted. But as to the future—only time will tell!



A cure for measles! A sheep with feet tied up in bed with you!

"SPARE the Rod and Spoil the Child." That used to be the way of it well into the 19th century when many of the heads of Victorian families were grim despots of whom their children were in mortal terror, and at the sound of whose footsteps they fell quiet as mice. "Papa" could be an awesome figure in the home, although, as his private world knew, he could be no end of a hearty good fellow at his Club. This was not true of all Victorian papas, but a great many were appalling hypocrites.

But let us go back a bit, to the early part of the 17th century when a growing Puritanism in English Society was ripening for the arrival of Oliver Cromwell to put paid to much natural merriment and social mirth. A great-grandmother who, for over a year, has had the loving custody of a little boy of three, returns him to his parents with an accompanying letter full of foreboding. She knows the stern and priggish nature of her grandson, Sir Ralph Verney, all too well. Just as we know today, and as children have always known, that "Gran" or "Gramp" is far easier to handle than Mum and Dad. These first are the "spoilers," while parents are always "going on" about something! "Son," writes great-grandmother, "he must be won by fair means. Let me beg you and his mother that nobody whip him but Mr. Parry; if

you do go a violent way with him, you will be the first that will rue it, for I verily believe that he will receive injury from it; indeed, Ralph, he is too young to be strudged in any forcing way."

But all in vain. The boy was, seemingly, so wayward that "strudgling" and cramming with learning and pious sermonisings were the only things for him. Like all children of his times, and of many decades thereafter, he must always stand bareheaded before his parents and address them as "Sir" and "Madam."

And how about "Mr. Parry" whom great-grandmother begged to be the only whipper of the little boy? Undoubtedly Mr. Parry was that growing figure in the well-to-do household—the tutor. The tutor might remain with his charges for most of their young lives; or, in other cases, prepare them for their entry to school and university. In the 18th century when no wealthy young man's education was considered complete without making "The Grand Tour" of Europe, it was invariably in the company of his tutor that he did so.

Had any of you boy readers been that young Master Verney, well whipped by your tutor, and, doubtless, by your father as well, you would have gone through some very strange phases of dressing. First, of course, you would have been "swaddled" as a baby in linen-bands. Next, when you were between one

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SHOOT!



A solemn moment for the 7-year-old Elizabethan or Jacobean boy! Instead of dressing like his sister he was ceremoniously "breeched."



LOOK LEARN **40 PAGES**

No. 485, 1st MAY, 1971

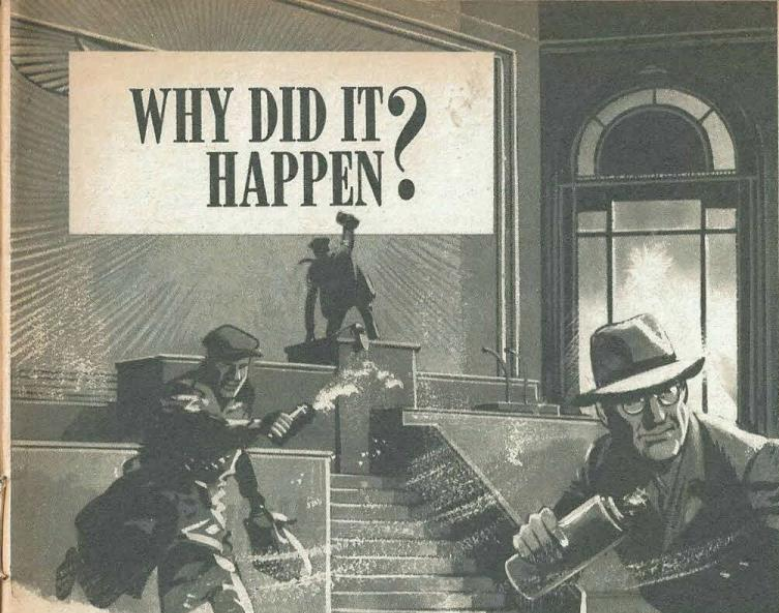
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THE RED CROSS CRUSADERS **SEE INSIDE**



WHY DID IT? HAPPEN?



The Nazis themselves made sure that the Reichstag would be burnt to the ground.

WORDLESSLY, the little group of men spread out through the darkened building. They were about to start a fire that would, six years later, affect the whole world.

Keeping to the shadows wherever street lights shone through the windows, they slipped silently from room to room of Germany's parliamentary building, the Reichstag. Each one scattered a combustible chemical over walls, floor and furnishings as he went.

Within half an hour they had re-assembled in the Reichstag's cellars. At a whispered order they filed through a door into an underground tunnel. The door closed. They had departed as invisibly as they had arrived.

Officially, no one should have been inside the building but the silence was broken by footsteps and furtive rustlings. Unaware that others had ever been there that February night in 1933, a half mad young Dutchman, who had been arrested a few days before for fire raising, was trying to start his own blaze.

Even now, 38 years later, no one is really sure of his place in the events of that grim night which Adolf Hitler's Nazi party used as an excuse to take control of the German government and nation.

All unknowing, the sick young Dutchman worked on in the darkness. Then the blaze started as suddenly as a struck match. Within minutes the ornate building became an inferno.

The flames that cast a lurid glow over the heart of Berlin were a portent of grimmer things to come. Twelve years later, the men who had used the fire as an excuse to seize power, had brought Germany to ruin and Berlin to near total destruction.

It is now known the fire was caused

by Adolf Hitler's National Socialist (NAZI) party in order to blame it on their strongest political rivals, the Communists.

The proof they brought forward was the shambling figure of the half-mad Dutchman, Marinus van der Lubbe. He freely admitted to starting it, though he denied he had had any help. But even better for Hitler, he also admitted to once having been a Communist.

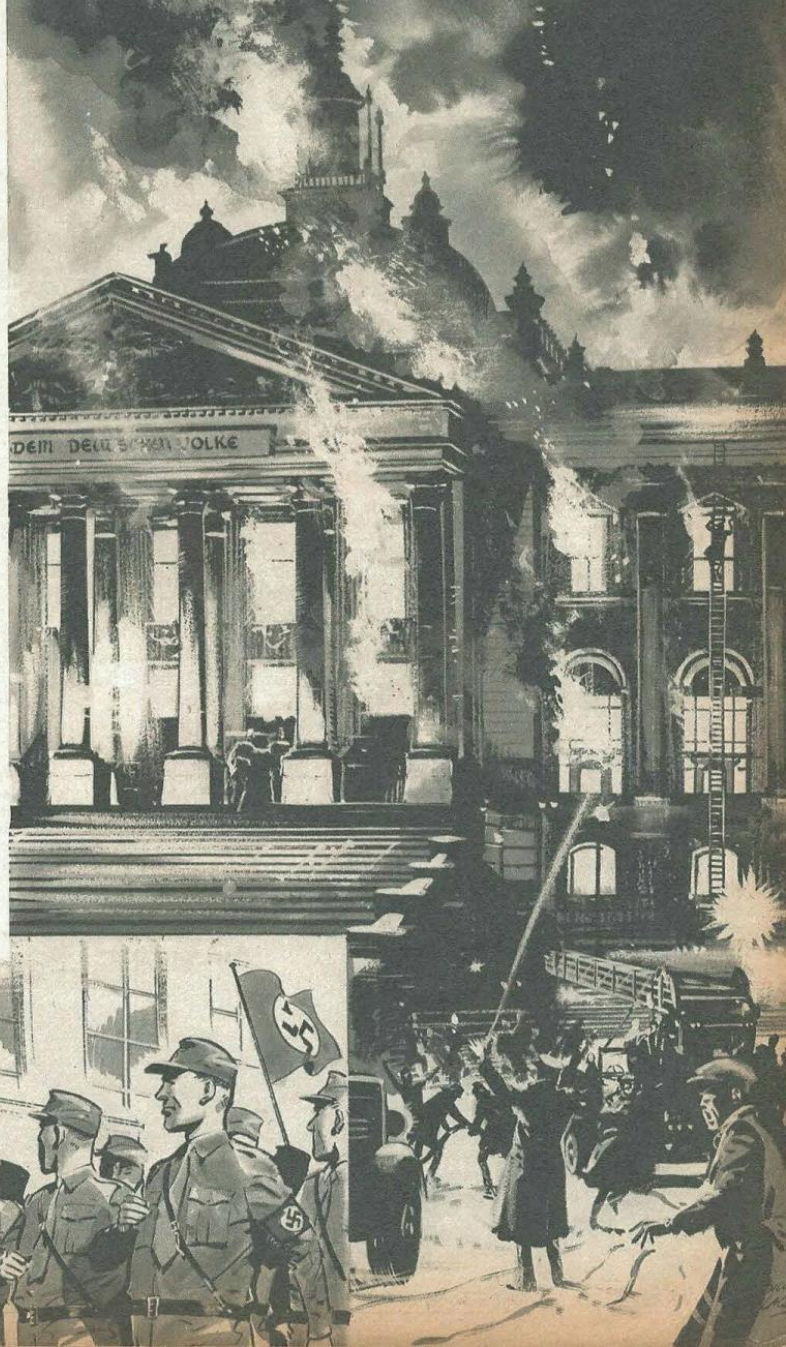
On this flimsy "evidence" Hitler, as German Chancellor, proclaimed a state of emergency. While it lasted his Nazi party took complete control of the government. It even incorporated its private army, the brown shirted "Storm troopers," into the official police. The biggest confidence trick of all was pulled, for the state of emergency remained in force till 1945.

Van der Lubbe and four Communist leaders were brought to trial.

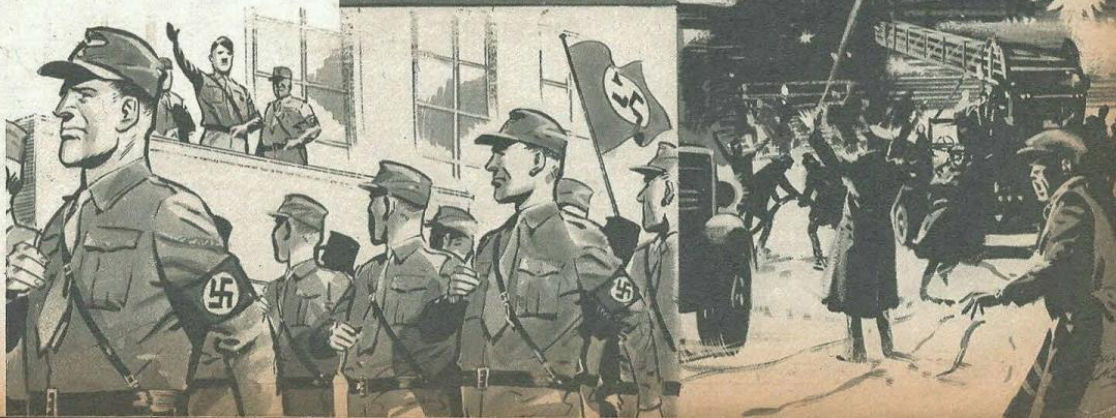
Unfortunately for Hitler, he did not have all the judges in his pocket. It took him another two years to do that. The court refused to convict the Communist leaders his police had arrested. The wretched van der Lubbe was, however, sentenced to death.

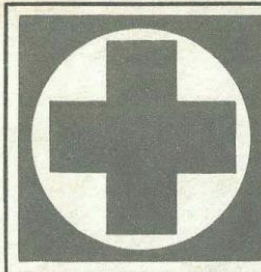
The fire, though, had served its purpose. Within months Hitler was installed as complete master of Germany. In the six years that followed he used his power to foment trouble with neighbouring states that led, eventually, to the Second World War.

THE FIRE THAT CHANGED THE WORLD



Hitler takes the salute from his Storm Troopers, who helped to bring him to power.





THE STORY OF THE BRITISH RED CROSS

This week we conclude our two-part series with the heroic work the Society did in the Second World War and its unending task before and after it...

PARCELS OF HOPE



This poster speaks for itself! The joy on the face of the prisoner of war receiving his parcel needs no comment. During the Second World War, as in the First, the Red Cross and the Order of St. John were combined for the duration of the struggles.

BEHIND the barbed wire! One prisoner of the Germans in the Second World War remembered that the most disheartening thing of all was "the sheer monotony" of camp life.

Added to this was sheer hunger, for if you were a prisoner your basic ration was less than that allowed the German over-80s. No wonder that many prisoners later said that their Red Cross food parcels had kept them alive. They were a week's food—and they came from home!

Even the crates were put to good use, being turned into anything from armchairs to cricket bats. The Red Cross also sent books and musical instruments, and Swiss members of the International Red Cross visited the camps to see that all was well and upbraided the Germans if it was not.

Prisoners of the Japanese lived in another, infinitely worse world, for it was almost impossible for the Red Cross to penetrate their camps, and the Japanese, believing that it was better to die than be a prisoner, treated their prisoners abominably. As for civilians, millions died in the ultimate horror of the Concentration Camps. Not until 1949 could the Red Cross force world opinion to recognise the human rights of civilian prisoners.

Yet as soon as the First World War ended, civilians had been embraced by the British Red Cross and other Red Cross societies. The whole field of social welfare was taken in, and this has increased every decade.

The Second World War of 1939-45 was a "people's war" as well as a soldiers' war, so this widening of the scope of Red Cross work was a vital one. As bombs screamed down on British cities, rescue teams of V.A.D.s (Voluntary Aid Detachments) went into action amongst the rubble finding and caring for the wounded.

As in the First World War the Red Cross combined with the Order of St. John, manning first aid posts, mobile medical units and running

hospital welfare services and a dozen other key jobs, including a postal message service to civilians trapped in enemy countries. At the very beginning of the war theirs had the unhappy task of organising the evacuation of youngsters from towns to safe places in the country.

Meanwhile, International Red Cross ships carried Red Cross parcels abroad where they were transferred to special trains. Over 400,000 tons of goods were carried in these ships of which only four were lost. But very tricky negotiations had to be overcome between enemies to get them through.

A typical parcel might contain meat loaf, apple pudding, cocoa, tinned meat and vegetable, sugar, margarine, condensed milk, chicken and ham roll, tea, sweet biscuits, golden syrup, cheese, sardines, chocolate and soap. Cigarettes and tobacco later went in separate parcels.

Horrors of war

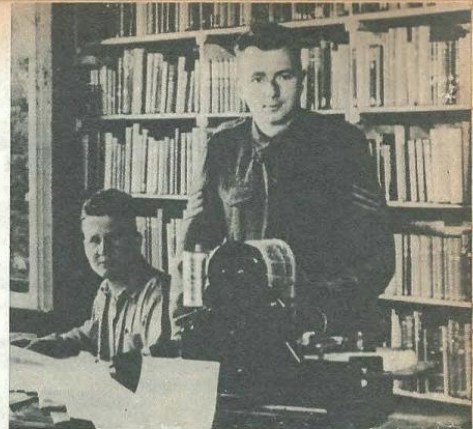
In the final days of the war, with the front line continually shifting, grim situations arose when prisoners were forced-marched away to other camps. But, typical of the power of the Red Cross was an incident at one camp. The British prisoners were ordered to Lubeck where typhus was raging. They refused. A local doctor who was an important member of the German Red Cross, sided with them and they were marched elsewhere.

At the other extreme were the horrors suffered by Russian prisoners of war because their Government had criminally failed to sign the Prisoners of War Convention of 1929. As for the Japanese, not only did they excuse their treatment of prisoners by claiming they





Left: A prisoner of war band, with instruments supplied by the Red Cross. Right: A Prison Camp library. The books on its shelves were also supplied by the Red Cross. Below right: The prisoners were mostly smiling when this photograph was taken, but there was little to smile about, especially if, unlike these men, you were a prisoner of the Japanese, beyond Red Cross aid.



had not confirmed the Convention, but they also "confiscated" Red Cross supplies of food and medicine, which resulted in the deaths of thousands of soldiers and civilians.

Since the war, the scope of the Red Cross has grown wider every year. Disaster relief is a vital part of its work, whether man-made or a natural disaster like the East Pakistan floods of 1970 or earthquakes. But there are also less dramatic tasks like helping travellers taken ill abroad, helping other Societies in the Commonwealth, hospital visiting, and so on.

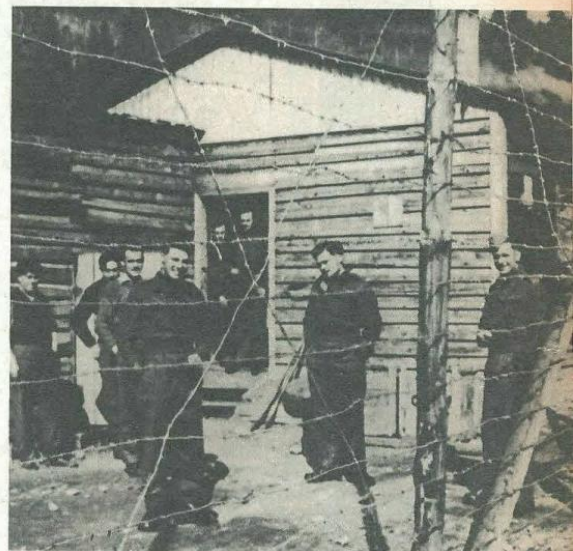
And there is a flourishing Junior Red Cross, founded in 1924, with over 80,000 members in Britain alone. Cadet Units range from eleven to school-leaving age: Junior members are from eight to eleven.

Cadets are very much part of the senior Red Cross and are often attached to a Voluntary Aid Detachment. They take courses in many subjects, including First Aid, Accident Prevention and Fire Protection, and they do community work. The Juniors study Health and

Safety.

So the British Red Cross, founded in the Franco-Prussian War of 1870-71, enters its second century of service. It is Britain's part of the great international organisation founded in 1863 by the Swiss, Henri Dunant. In Moslem countries the Red Cross is the Red Crescent: in Persia it is the Red Lion and Sun. But the task is the same whatever the name—to relieve suffering wherever it exists.

★ If any readers of LOOK AND LEARN are interested in joining the Junior Red Cross, they should apply to the British Red Cross Society, 8/9 Grosvenor Crescent, London, S.W.1 or any local branch.



The great floods in East Pakistan last year caused unbelievable suffering to millions of survivors. Naturally, the Red Cross went straight into action with vast supplies of relief goods sent out East as rapidly as possible. Red Cross helpers, too, were soon on the spot giving welcome aid.



EVERY MONDAY, 9 new pence

SEE INSIDE



THE VICTORS OF THE ALMA

CONTINUED

would have been over. As it was, the failure to reconnoitre the ground ahead led the French Generals to urge a long "flanking march" round Sebastopol so that an attack could be made from the south. As always—or almost always—Lord Raglan acceded to a policy which was to have calamitous consequences.

Meanwhile letters were streaming in to *The Times*, trouncing the Government for its inadequacy, and demanding that it should go.

It was only a matter of months before the Government actually did go, but long before that the British public had taken matters into its own hands. The correspondence columns carried more, now, than mere indignation. Mostly they were practical suggestions, especially for raising money to buy comforts for the wounded. The whole staff of the Crystal Palace donated a day's pay to a fund set up by *The Times* for this purpose; the lessee of the Victoria Theatre offered the receipts of one performance—and individual donations poured in. In the end the fund totalled more than £20,000. Depots were set up all over the country, where clean linen was collected for bandages and dressings.

Nurses go to war

But money and bandages were useless without more doctors and nurses. One reader who signed herself "A sufferer by the present war," writing eloquently of the sufferings of wives and mothers of the soldiers dying uncared for in the Crimea and Scutari, at last made a suggestion which was to have results far beyond anything she, or anyone else, could have anticipated.

"There are," she pointed out, "numbers of able-bodied and tender-hearted Englishwomen who would joyfully and with alacrity go out to devote themselves to nursing the sick and wounded if they could be... placed under proper protection..."

There was indeed at that moment at least one such woman, not only ready and willing, but who had been preparing herself for many years for this opportunity. Her name was Florence Nightingale. After only a token attempt to persuade the country that all was really well in the hospitals of Turkey, the Government accepted her offer to help, and in due course she arrived in the Crimea, with a small band of devoted followers.

What followed is not only history, but legend.

LOOKING INTO SCIENCE



Could super fast hovercraft turn our waterways into commuter highways, and...

WILL THIS EVER TAKE THE PLACE OF THIS?

IN Britain, the hovercraft is already a familiar sight. Its inventor, Christopher Cockerell, was knighted for his work, and a variety of vehicles which ride on a cushion of air have been in regular passenger service around the coasts of Britain since 1965.

Since August, 1968, passenger and car ferry craft have made possible a year-round ferry service to France. Already, well over a million passengers and

120,000 cars have crossed the English Channel by hovercraft. The 165-ton *Mountbatten* type, which operate the cross-Channel route, is also used on a regular service across the Solent to the Isle of Wight.

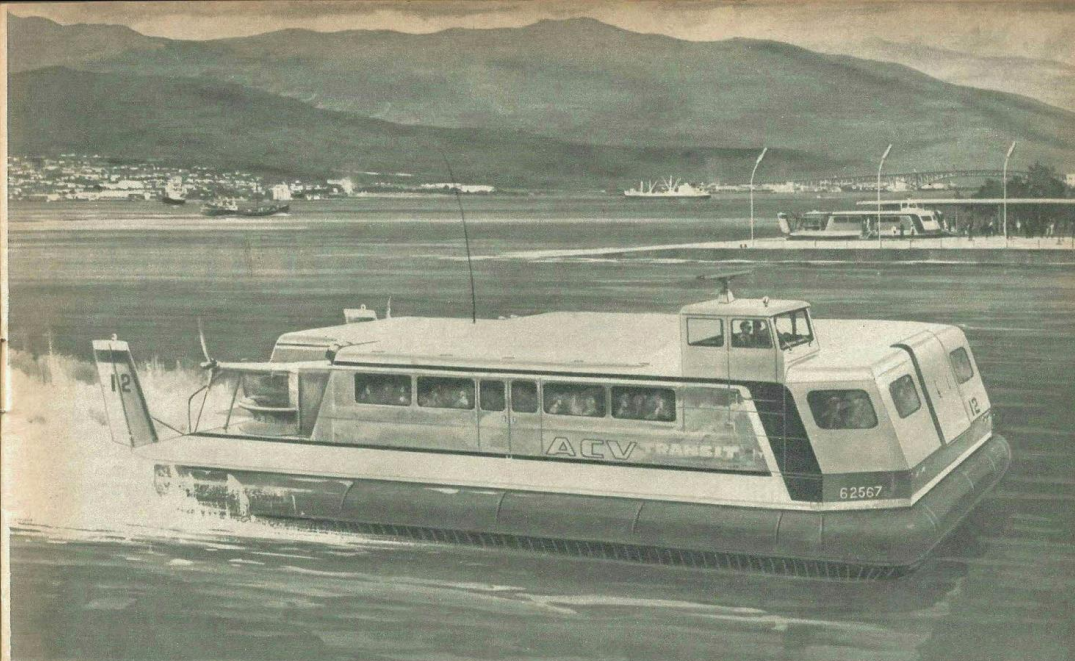
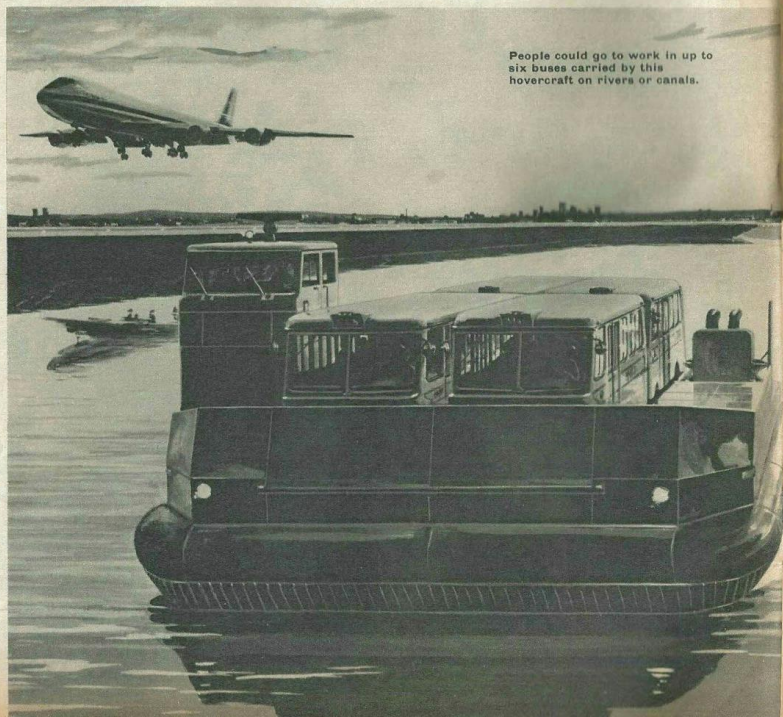
Besides hovercraft, there are other vehicles which ride above the surface. Their name in America is Surface Effect Vehicles (S.E.V.), and they are craft which, supported by a cushion of air, ride with ease and speed over land and

water, as well as ice, snow and marshy land.

They came into the minds of naval architects as long ago as the mid-1880s. In searching for ways to overcome the frictional drag between a ship's hull and the water, the architects thought that speed could be substantially improved by putting a thin layer of air between the hull and the water.

One of the first uses of this theory was made in 1916 when the Austrian Navy built an experi-

People could go to work in up to six buses carried by this hovercraft on rivers or canals.



mental torpedo boat that used a crude turbine-like device to pump air down through the craft's hull. The craft reached a speed of 40 knots.

But there were many snags to be overcome and the idea was put aside until the 1950s when Christopher Cockerell put his mind to the problem. In 1955, he applied for a patent for a device for making an air cushion. This was called a peripheral jet.

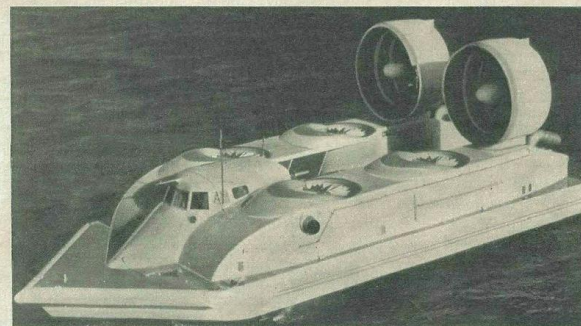
You are probably familiar with the history of the hovercraft in Britain, for it has often been mentioned in LOOK AND LEARN.

At about the same time, American firms were starting to experiment in the same field. By 1959, Bell Aerospace had produced two 18 ft. experimental S.E.V.s that rode on a cushion of air just a few inches thick. These were used to study the air cushion principle and control techniques.

Two years later, the firm built a 1½ ton machine that hovered at a height of a foot and went over land or water at 50 knots.

Other hovercraft came along and now Bell and the British Hovercraft Corporation, partners in an agreement, are the biggest S.E.V. manufacturers. Between them, they have designed and built the 90 or so transport S.E.V.s in the world.

Now what of the future? One of Bell's ideas is to take people to work on buses which would drive straight on to an S.E.V.



Left: An early pioneer of American hovercraft research. This is a Hydroskimmer made by Bell Aerospace.



Britain, which led the way with hovercraft development, now runs regular cross-Channel ferries with hovercraft like that shown below.

THE LADIES GO INTO BATTLE

CONTINUED FROM PAGE 4

"washed her way" through Turkey, Bulgaria and the Crimea, and later followed her husband, "Soldier" Evans, out to India. When she died, aged 84, in 1914 she was buried with full military honours, which she had richly earned.

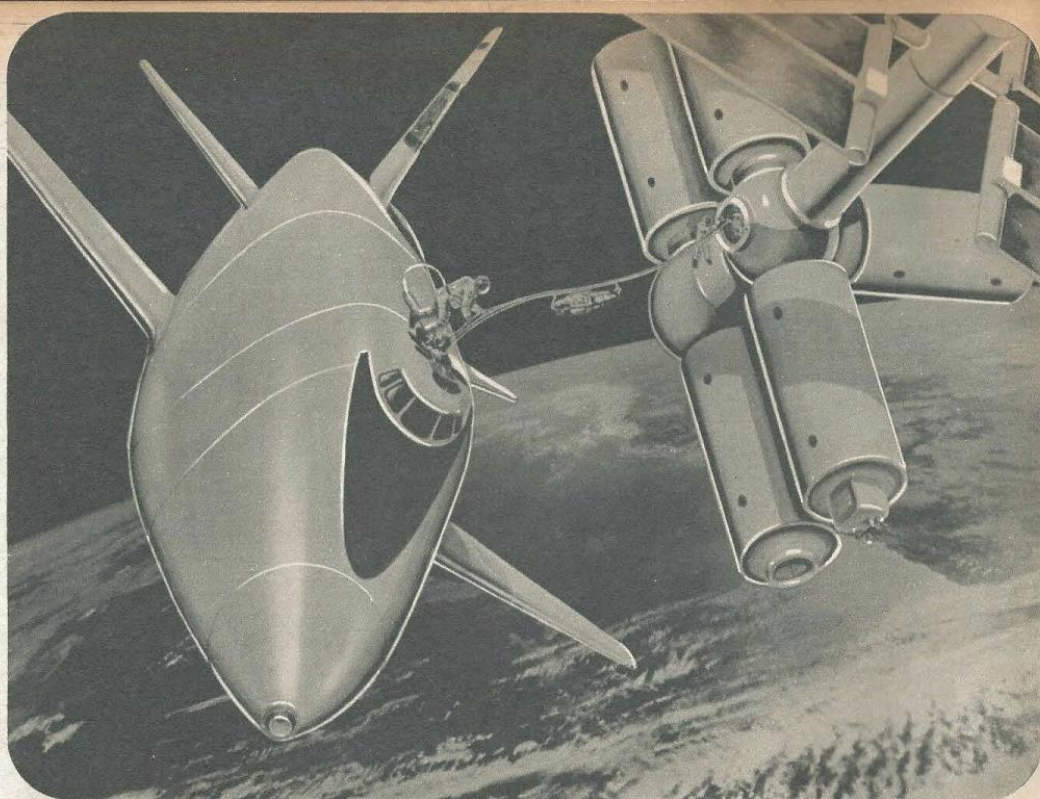
But all the women with the British army were not "soldiers' wives." Some were the gently-bred wives of officers, who went out not to help the army with its day-to-day tasks, but merely for the adventure, and "fun". Best known of these was Mrs. Fanny Duberley, indomitable wife of the Paymaster of the 8th Hussars, who kept a lively and entertaining diary of her exploits throughout the campaign.

Together with the Travelling Gentlemen—non-combatants who regarded the Crimean War as a sort of glorified military tattoo—they formed an audience for major battles. Military bands frequently entertained them with "suitable airs" while they waited for battle to be joined.

The allies were not alone in having such a frivolous retinue. After the battle of the Alma a group of allied soldiers came across a picnic basket, with six cold chickens and two bottles of champagne . . . a number of ladies' shawls and parasols, and a lady's bonnet "very nicely trimmed."

One of the most bizarre women to take part in the Crimean campaign, though, was Mrs. Mary Seacole—"Mother Seacole" as she was known—who ran a hotel-restaurant on the high road above Balaklava. Jamaican-born daughter of a Creole mother and Scottish father, she learned catering in her mother's boarding-house in Kingston. She had a passion for travel and excitement, and had a habit of turning up wherever the action was hottest. In addition to her catering skill she had an instinct for nursing. Russell even referred to her as a "female doctor" and reported that she "cured all manner of men with extraordinary success," being "always in attendance near the battle-field to aid the wounded, and earned many a poor fellow's blessing."

She had in fact tried hard to join Florence Nightingale's team, but one glimpse of the apparition in its flame-coloured dress and wide-brimmed, scarlet-ribbon-trimmed hat shading a dusky face, was enough for the austere Lady with the Lamp. There was just not room for both of them in Scutari. . . .



LOOKING INTO SCIENCE

SPACE RESCUE

"Space Tragedy," scream the newspaper headlines. "Orbiting station blows-up, injuring crewman." If there is ever such an emergency in real life, N.A.S.A., the American space administration, has plans to deal with it. Their life-saver is a Space Plane to be pick-a-backed out of Earth's gravity by a booster rocket. The two then separate, and the Space Plane flies on to the orbiting station. The injured crewman (above) is pulled by lifeline to the Space Plane, and the other crewmen will follow.



LOOK LEARN

40
PAGES

No. 492, 19th JUNE, 1971

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IT COULD REALLY HAPPEN

Read the startling story
of London's secret
peril—

See inside



FREEDOM OF THE SKIES...

It was bound to happen. Once man had mastered the skies, he set his sights on mastering space as well. Less than 66 years after achieving manned powered flight, men walked on the Moon.



1. The American rocket plane X-15, and later versions of it, cracked speed records regularly in the 1960s. The one above is an X-15A. Powered by an ammonia and liquid oxygen engine, the X-15 was carried to a high altitude by a Boeing B52, then let loose to continue on its own. By the late 1960s, speeds of over 4,500 mph had been reached. This type of plane has to be built of a heat-resisting metal like stainless steel or titanium.



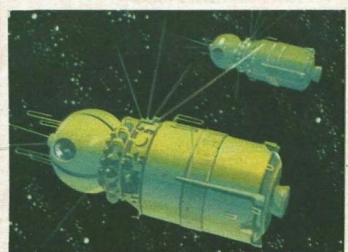
2. The Boeing X-20, known as the Dyna-Soar, is an inhabited space capsule with an aerodynamic shape. It was first successfully fired in 1963, being built to reach extra-atmospheric space with the help of a Titan III rocket. The pilot discards a cockpit heat shield after take-off. The Dyna-Soar was designed to re-enter the earth's atmosphere in a series of "glides" through the various atmospheric levels on its return to earth.



3. Before the first spacemen went up it was absolutely vital to study the behaviour of the human body under the sort of conditions to which it would be subjected during space travel. The picture shows a simulator. In it the pilot controls the simulator and follows the directions shown by the instruments. The stars which he will see during a real space journey are projected on to an area near the ceiling of the simulator.



4. History has a way of forgetting the second men to achieve some extraordinary feat, but not the first, and one "first" who will never be forgotten is Yuri Gagarin. On 12th April, 1961, in Vostok I, Major Gagarin, a 37-year-old Russian airman, became the first successful spaceman, making a single orbit of the Earth. His epic feat took 108 minutes in all, and the world was thrilled, as it was to be when men landed on the Moon.



5. The Russians were the leaders in the early days of the race to reach the Moon first. After Gagarin's triumph, the next step in the experimental phase of making long distance space flight a real possibility was taken by the Soviet Union. In August, 1962, the Russians sent up two capsules into space piloted by Andrian Nikolaiev and Pavel Popovic, who remained in space for about 94 hours. More marvels were in store.



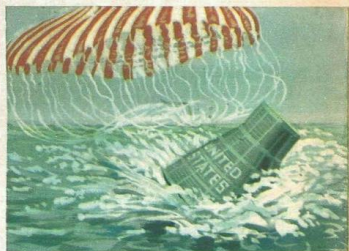
6. On 18th March, 1965, the Russian satellite, Vostok II, went into orbit with Colonels Leonov and Belyaev inside it. During its second orbit, for the first time in the history of astronautics, a man walked in space! It was Colonel Leonov who made the sensational walk: he was in space for about 20 minutes, and for more than 12 minutes he floated at the end of a line. In all this flight made 17 orbits and covered about 447,000 miles.



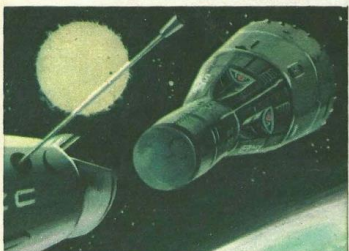
7. After several suborbital flights, beginning in 1961, the Americans, too, reached space when the astronaut John Glenn was launched from Cape Canaveral, later Cape Kennedy, in February, 1962. Glenn completed three orbits around the earth on a Mercury capsule, remaining in flight for four hours and 56 minutes. But that year the Russians were still ahead: Vostok 3 with Andrian Nikolaiev aboard made 64 orbits.



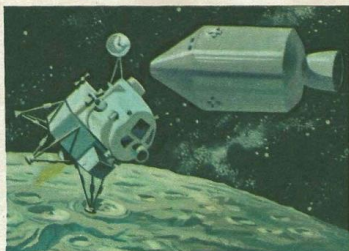
8. The interior of the Mercury capsule contained an air-conditioning plant, the control mechanism, the manoeuvring gear, radio communications equipment and parachutes. The special chair in which the pilot sat was made to fit his own body shape, as this allowed him the greatest amount of movement—not that that was very great! American astronauts have always been more tightly packed into their compartments than Russian ones.



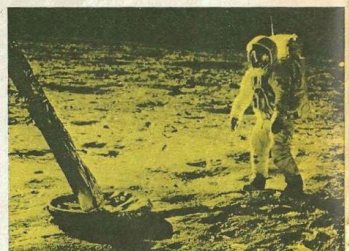
9. After its flight through space, the Mercury capsule came down in the Atlantic Ocean where naval units were waiting for it. The lifting of the capsule out of the water was, like later returns, carried out by a patrol of helicopters belonging to NASA, the American Space Agency. Mercury flights were successfully completed by 1963, having proved that men could live in orbit and that the procedures for returning to earth worked.



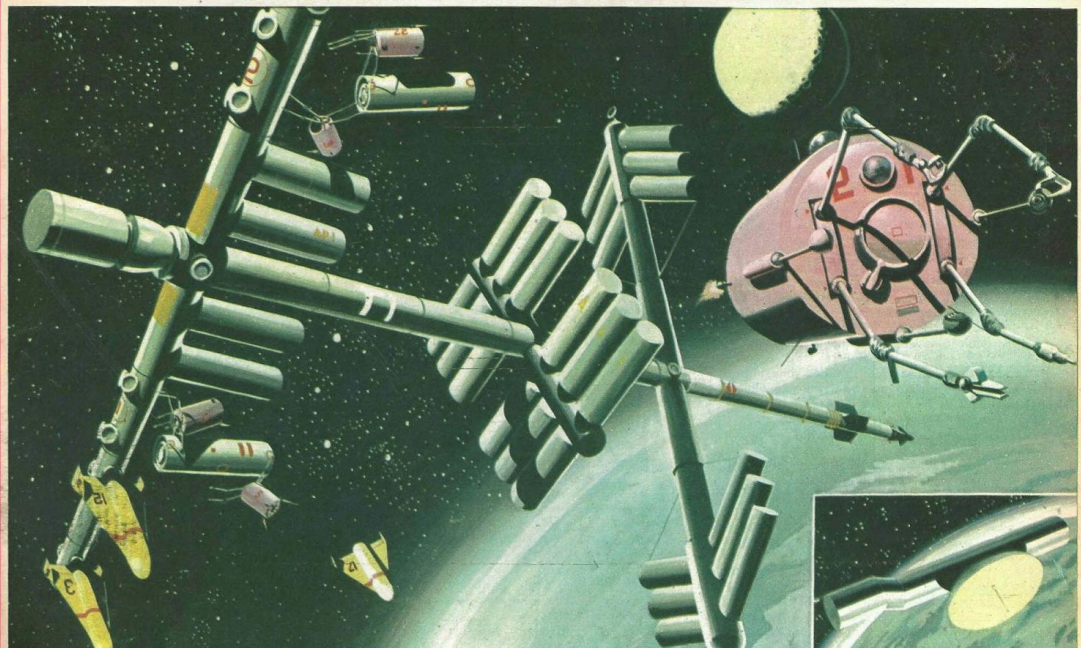
10. Next came the Gemini project. Gemini spacecraft housed two astronauts and were the next stage in the Moon programme. The project was primarily intended to allow the two pilots some control over their craft and not just be passengers as in Mercury. Launchings were carried out by Titan rockets. Gemini enabled astronauts to practice meeting and docking manoeuvres, as the Moon programme required two separate modules.



11. As early as 1961, manned Apollo spacecraft were chosen to make the Moon landings, launched by the Saturn 5 Rocket. The world soon learnt that when the spacecraft reached lunar orbit, one part of it would come away and descend, with two men aboard, on to the Moon's surface. Fortunes were spent on the Apollo programme during the 1960s, and millions watched the Apollo spacecraft on their missions and saw the control centre at Houston.



12. The first manned Moon landing took place on 21st July, 1969, when Neil Armstrong, commander of Apollo II, and Edward Aldrin, stepped on the Moon's surface. They walked easily, took soil samples, raised the American flag and put up a notice which ended "We came in peace for all mankind." Then they climbed into the lunar module, took off, docked with the command module and rejoined Michael Collins within it.



13. So, in a few short years, man had conquered the skies and had begun the most incredible adventure of them all, the conquest of the Universe. Other men have now trodden on the Moon's surface, as yet all of them Americans, for the Russians have opted out—at least for the time being—of a programme for getting men on the Moon, preferring to get information from machines sent there. This is a strong argument that this is the more

efficient method anyway, though not so thrilling! Meanwhile, the first inhabited space station is an eagerly awaited target. The illustration shows an artist's impression of what such a construction might look like. The space station will be made up from a series of identical parts, fitted together to form a working unit. Special space tractors, fitted with mechanical limbs controlled from the inside, would carry out the

construction work, while other vehicles would transport the men who would need to live in space to and from the Earth's surface. In the bottom right corner is pictured the first stage of this type of construction. A far cry from the Wright Brothers, the balloonists, Alcock and Brown? Perhaps! But the spirit needed is the same. In the last resort, though, it is perhaps the earlier pioneers, unaided by scientific marvels, that we admire most of all!

LOOK AND LEARN ENTERTAINMENT SUPPLEMENT

MEN AND MACHINES

Ship That Sailed To Meet Itself!

A TUBBY giant ploughed through the waters of the Great Lakes, the five fresh water lakes between Canada and the U.S.A. It had the strangest shape for a ship.

The forward section had a navigational bridge and accommodation for the crew. Jammed hard against this was the stern packed with a large elevator for unloading the cargo. But there was a snag—there was no storage space for any cargo.

Named the *Stewart J. Cort* and owned by the Bethlehem Steel Corporation of the U.S.A., it had been designed to carry 52,000 tons of iron ore from ore fields to the foundries.

The plans showed that it was to be 1,000 ft. long and 105 ft. across the beam, the largest ship ever built upon the Great Lakes.

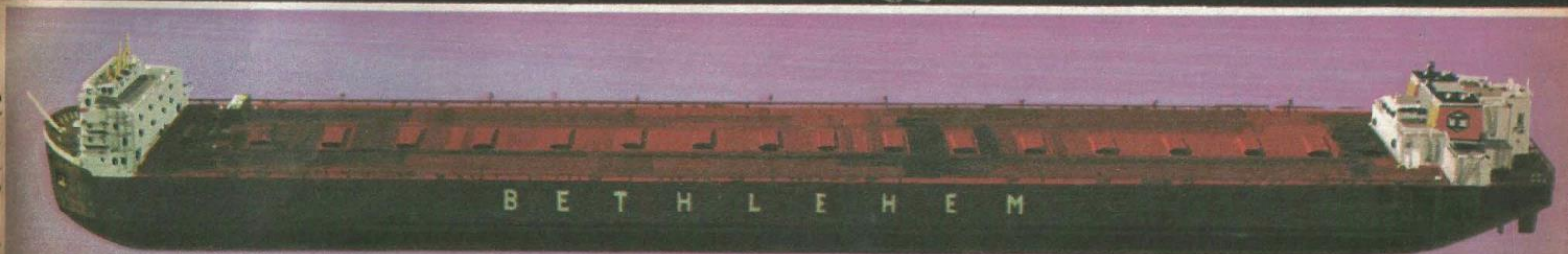
When it looked like the picture below, it was certainly no candidate for a size record. But it was only half finished.

The bows and stern were made in one shipyard, all the propulsion and other machinery being in the stern. These two parts were joined to make a 185 ft. ship which was then sailed to another yard. Here, the two sections were separated and then joined to a huge 815 ft. midbody, to make a 1,000 ft. bulk ore carrier (bottom picture).

To make the midbody was a mammoth task. Parts built in various parts of the works were brought together in the main assembly shop. These were constructed, at the end of the dock, into 48 ft. complete hull sections, built on-end.

As each 800 ton section was finished, it was laid flat and the dock partly flooded so that the section could be floated down the dock 48 ft. to make way for the next section. This was repeated for the 17 sections making up the midbody of the ship.

Finally, the bows and stern were joined to the body and the giant ship was finished.

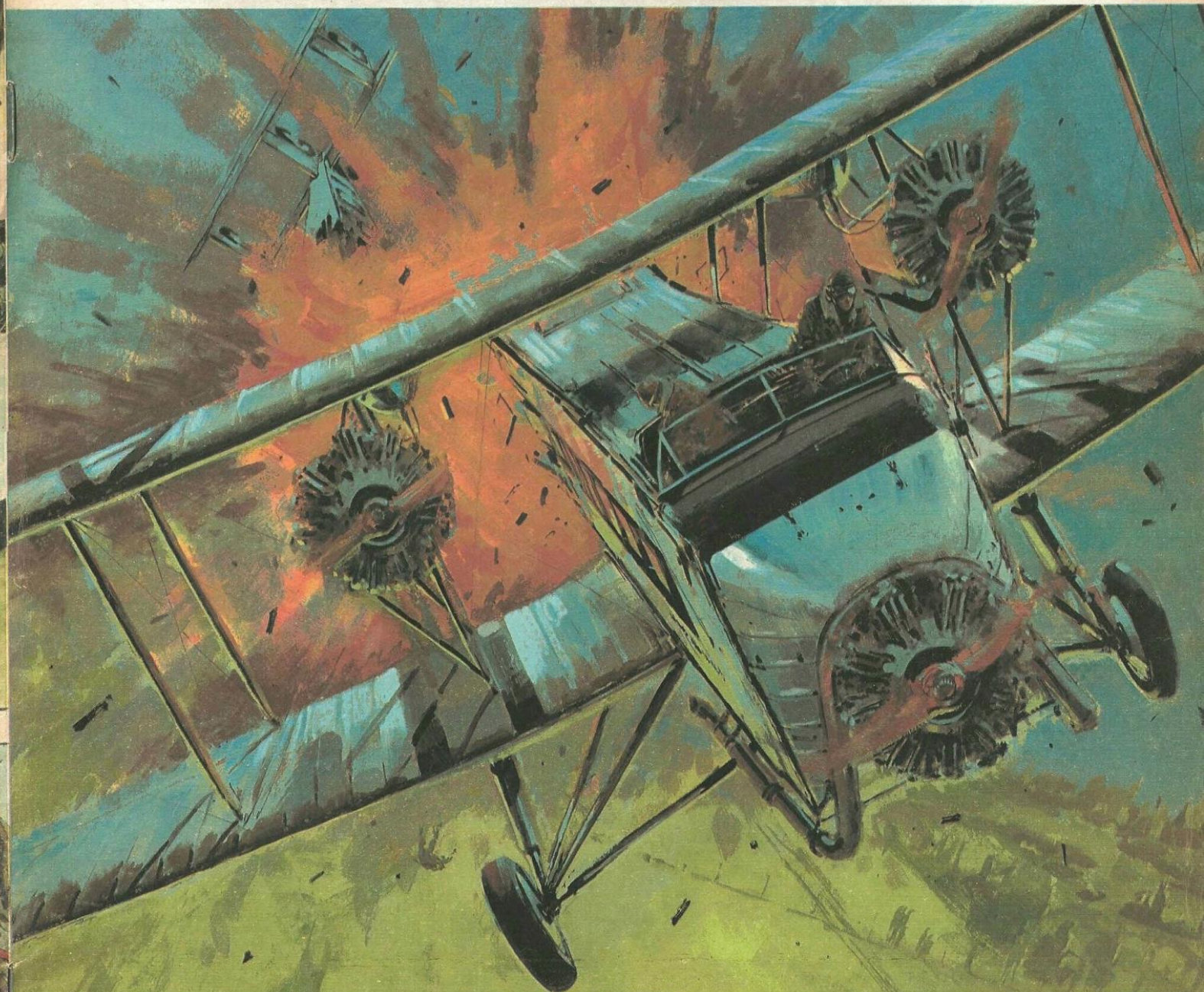


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THE FATAL FLIGHT

SEE INSIDE

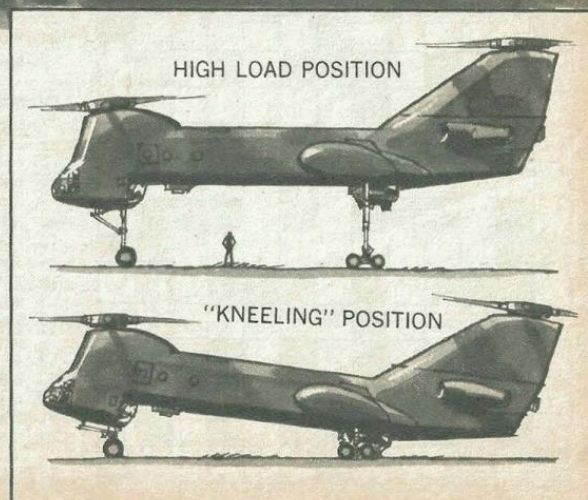


The Flying Heavyweight!

The monster shown in the picture above is our artist's impression of the winning design in an American competition to find a heavy lift helicopter (known as H.L.H. for short) for use by all the three armed services.

Designed by engineers of the Boeing-Vertol Company, the H.L.H. is capable of lifting a weight of 22½ tons. It is 83 ft. 10 in. long and 32 ft. high. Each of its two four-blade rotors has a diameter of 90 ft. Bulky loads will be carried under the fuselage and not inside it. They will be suspended from two lifting hoists, each with a 150 ft. cable. The hoists will be controlled by a crewman who has his own rear-facing cockpit so that, like the driver of a big crane, he can see clearly what is going on below. The diagrams on the right show how the H.L.H. landing gear can be raised to lift it 14 ft. off the ground to straddle tall loads. Alternatively, its rear fuselage can be lowered to a "kneeling" position to take internal loads, like men and vehicles, into the fuselage through rear doors.

Some of the problems for the engineers to solve will be the making of the huge titanium rotor hubs, a new system for transmitting the power of the engines to the rotors, and an automatic flight control system to take some of the workload off the pilots. Will helicopters get any bigger? The leader of the design team sees no limit to their growth. As he put it, "If we want to build a helicopter as big as the Boeing 747 jumbo jet, there will be plenty for it to do."



Burchell

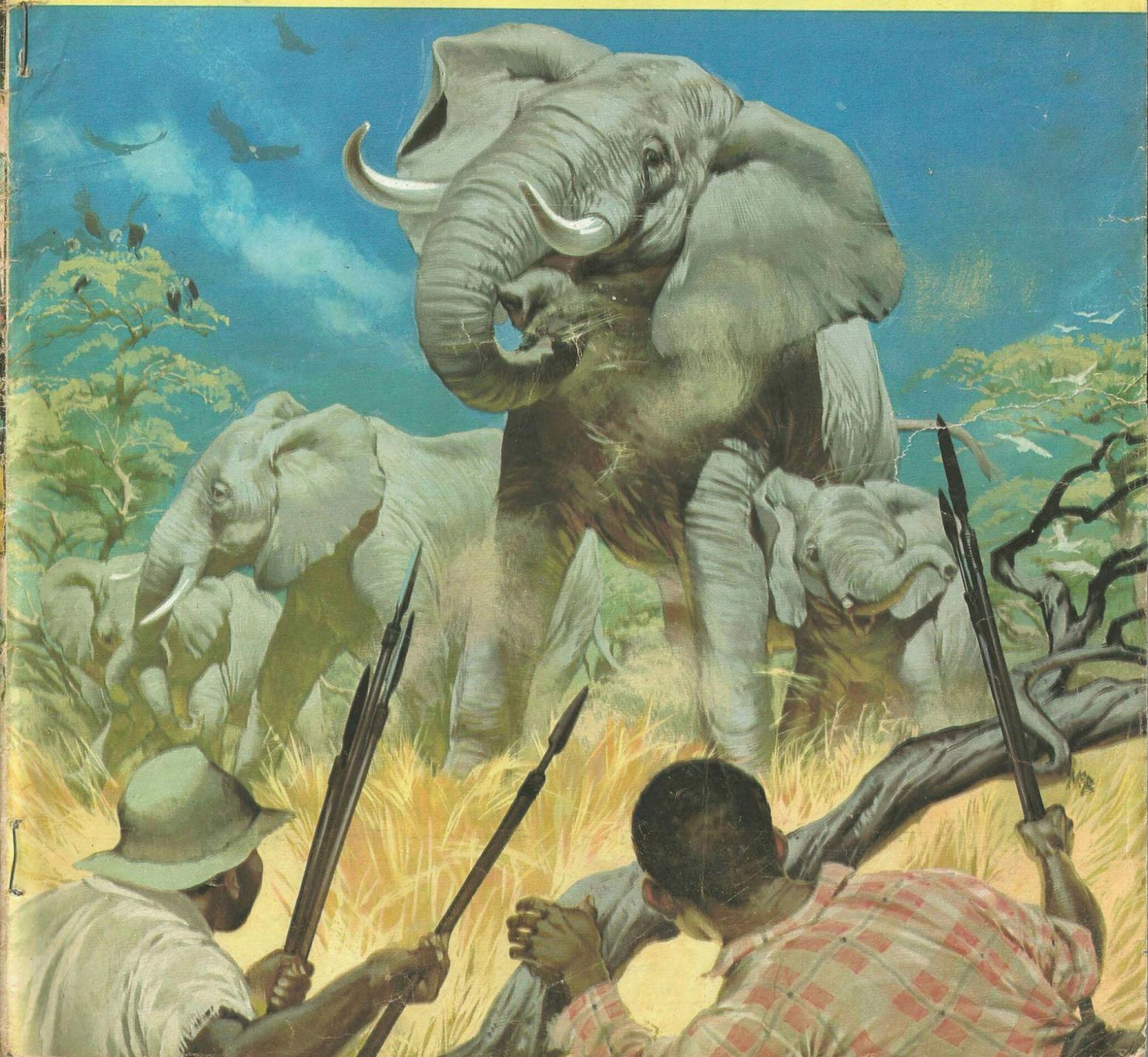
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THE IVORY POACHERS — WILD LIFE IN DANGER — See inside



Engineering in Space

For centuries Man has been an engineer. During the times of the Romans he built immense aqueducts of stone to carry water into the deserts so that he could grow food. In more recent times engineers have used steel to span rivers with bridges, erect skyscrapers, and build 100,000 ton tankers to bring us oil and natural gas from distant lands.

Today Man has conquered Space. Regular trips are being made to the Moon. Space "probes" are busily exploring the Planets. Today the engineer is making plans to venture into Space along with the astronauts.

In the past, the work of the engineer has mainly been concerned with finding new sources of power, building homes for people to live in, and thinking up new ways of supplying us with water, food, and the raw materials we need to make things in our factories.

In the years to come the engineer will be doing exactly the same sort of work in outer space. On these two pages are just a few of the imaginative engineering schemes which might be carried out in our lifetime.

'PROJECT VENUS'

In many ways the planet Venus is an ideal place for human beings from Earth to colonise in the future. Venus is about the same size as our Earth, with a diameter of 7,600 miles compared with the 7,900 mile diameter of the Earth. Venus is closer to the Sun than we are—93,000,000 miles for the Earth compared with 67,000,000 for Venus.

As it is today, however, Venus would be an impossible place for human beings to live.

At the surface Venus has a temperature of about 1,000 degrees Fahrenheit, which is very much hotter than a cooker oven when the heat regulator is turned full on.

When rain falls on Venus it turns to steam immediately when it strikes the red-hot surface. Because of this Venus is completely covered with a thick blanket of cloud. If we were able to stand on Venus, protected from the raging heat by asbestos suits, we would never see the Sun during the day, or see the stars at night.

Engineers have now hit upon an ingenious way of making Venus habitable for human beings. And the clue to their scheme is

the fact that the atmosphere of Venus consists mainly of carbon dioxide.

The engineers plan to "seed" Venus with plant life.

Here on Earth the oxygen we breathe is almost entirely supplied by plants, which use the green chemical compound called "chlorophyll" to manufacture oxygen from the carbon dioxide in our atmosphere.

The plants used to "sow life" on Venus would probably be tiny single-celled green organisms called Algae, which are found in their billions on the surfaces of ponds.

Fleets of satellites would be sent from Earth to orbit around Venus. These satellites would be "armed" with small rockets, whose "nose-cones" would contain millions of algae. By radio-control from Earth these rockets would be "fired" down into the atmosphere of Venus. The nose-cones would automatically break open, seeding the Venus atmosphere with algae.

As they multiplied, the algae would make oxygen from the carbon dioxide. And as they grow, drifting about in the clouds, more and more oxygen will be produced. The atmosphere will gradually cool down, and more and more rain will fall. Finally the surface will cool, and rivers will begin to flow. Lakes will form, and fresh rivers will be born, carrying more and more water down to a new-born sea.

'PROJECT SUN-RAY'

Here on Earth we are quickly running out of oil, natural gas, coal, uranium, and other means of generating electricity. In the near future we will be forced to use energy from the Sun, which is almost a never-ending source of energy which costs us nothing!

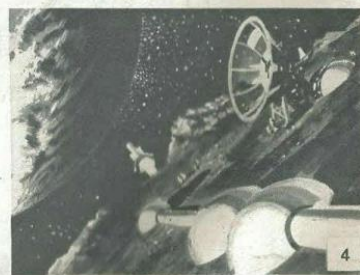
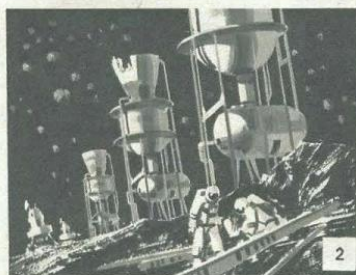
Unfortunately "solar energy", as it is called, can only be harnessed efficiently in a few countries near the equator where there is brilliant sunshine most of the time. In countries like Britain, for example, we *do* have some sunshine, but it is rarely strong enough to make a very useful power source.

The situation could be vastly improved, however, if so much of the sunshine was not wasted. Most of it, unfortunately, shines past the Earth, and is "lost" in space.

This picture shows one scheme which space-engineers are developing for "capturing" lost sunshine. The scheme depends upon the fact that "weightlessness" in space can help us build enormous structures which would be quite impractical down here on the Earth's surface.

Imagine a fleet of satellite "space stations" orbiting the Earth. Each space station would carry a huge curved mirror made of very thin aluminium alloy. This mirror would focus the Sun's rays down on to a solar power station on the ground. Due to weightlessness this mirror could be over a hundred times the size of a football ground. A whole fleet of such mirrors would have to be used, because as they orbited they would soon be "out of sight" behind the Earth, and a new one would have to come into view to supply the ground station with sunlight. Automatically-controlled electric motors, run by "solar-cells" would keep the mirrors slowly turning and focused down on to the Earth solar power-house.

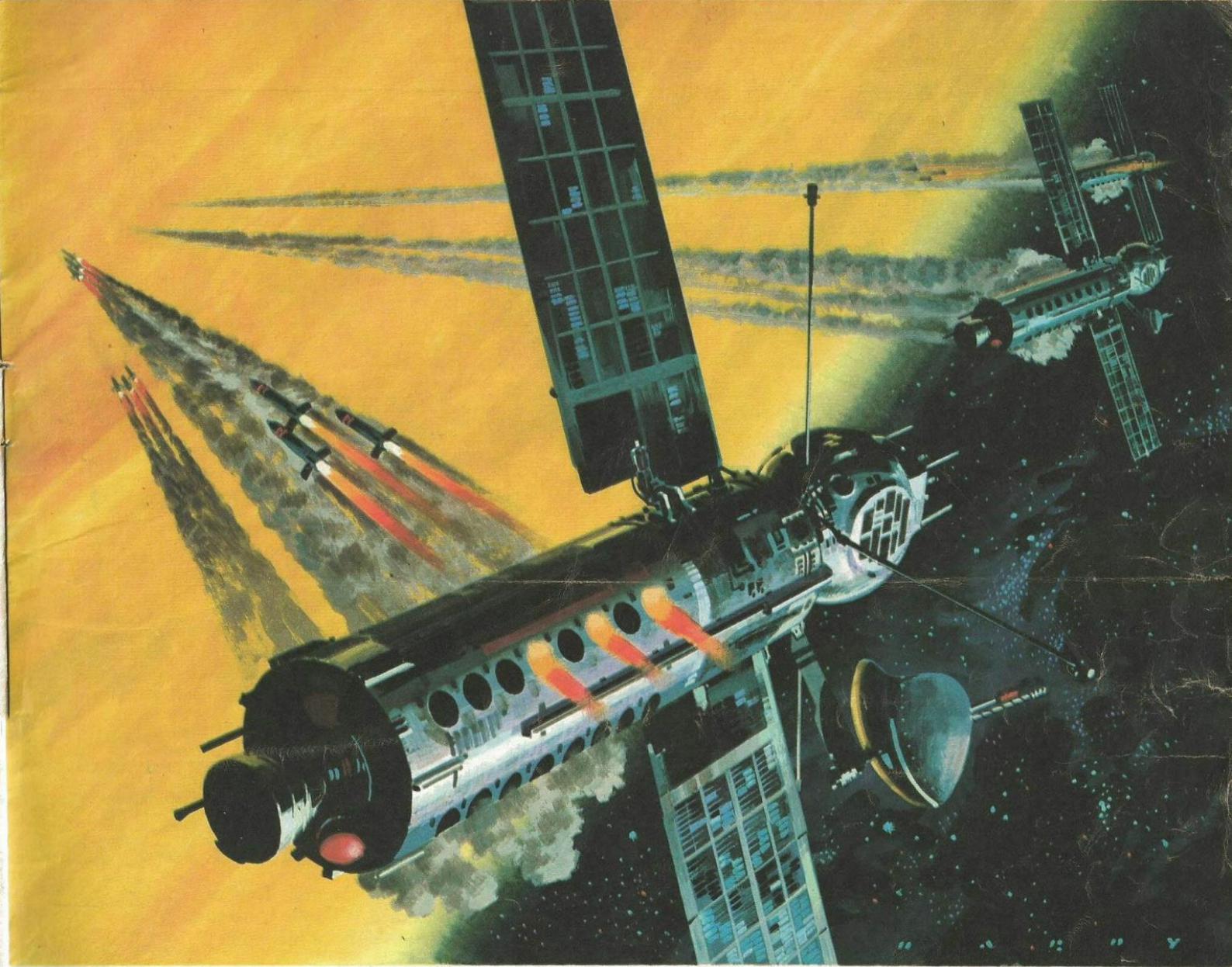
'PROJECT ADONIS'



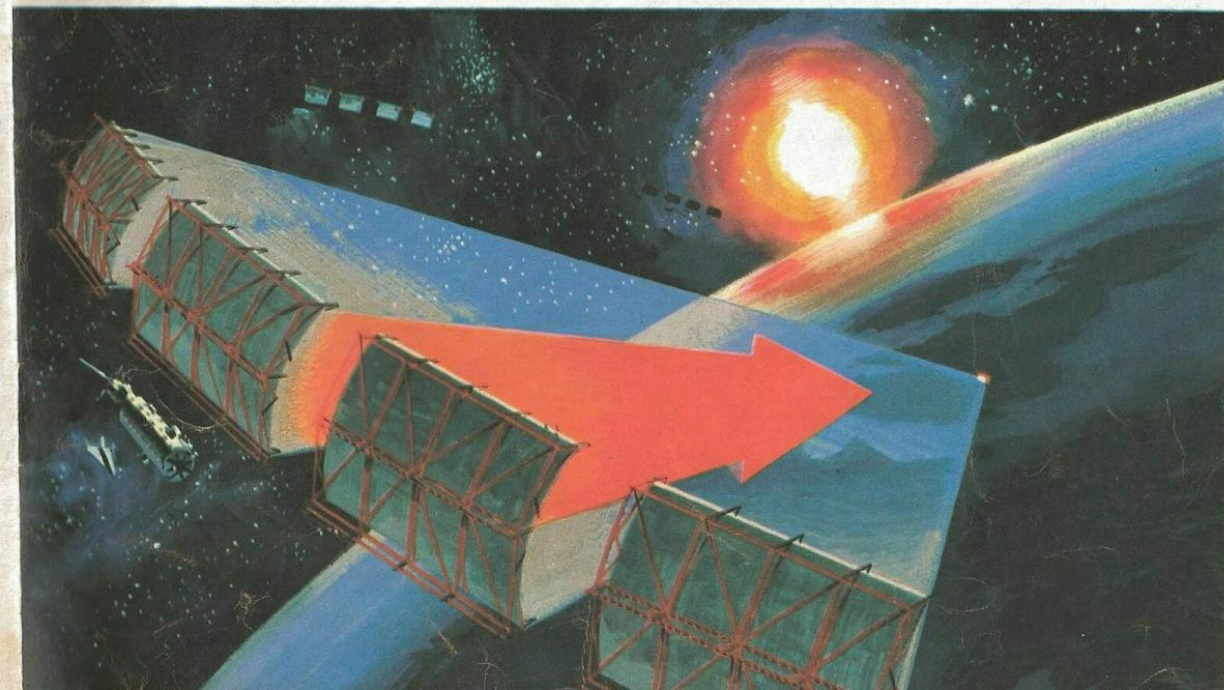
Orbiting between Mars and Jupiter are more than 50,000 "miniature" planets called Asteroids. Most of these are no larger than boulders. Some of the largest have names. Ceres, the largest, is about 430 miles in diameter. Slightly smaller asteroids are named Pallas, Vesta, Astraea, and Icarus.

The asteroid Adonis is one of the most interesting from an engineering point of view. Adonis, a huge jagged lump of rock about half a mile long, would make an excellent space station for use in an Earth orbit. These four pictures show how Adonis could be brought to Earth:

- 1 A fleet of space ships nears Adonis, carrying engineers, technicians and astronauts.
- 2 Landings are made, and huge rockets are fitted to one end of the asteroid. These rockets are powered by atomic motors.
- 3 The engineers leave in their space ships, and the asteroid slowly begins its journey towards the distant planet Earth.
- 4 The asteroid has arrived and has taken up an Earth orbit. On it have been built dome-shaped homes, laboratories, and store houses. An astronomical observatory is being built, and a vast radio-telescope. A ground-to-Adonis space capsule is bringing scientists up for a year's "tour of duty" on Adonis.

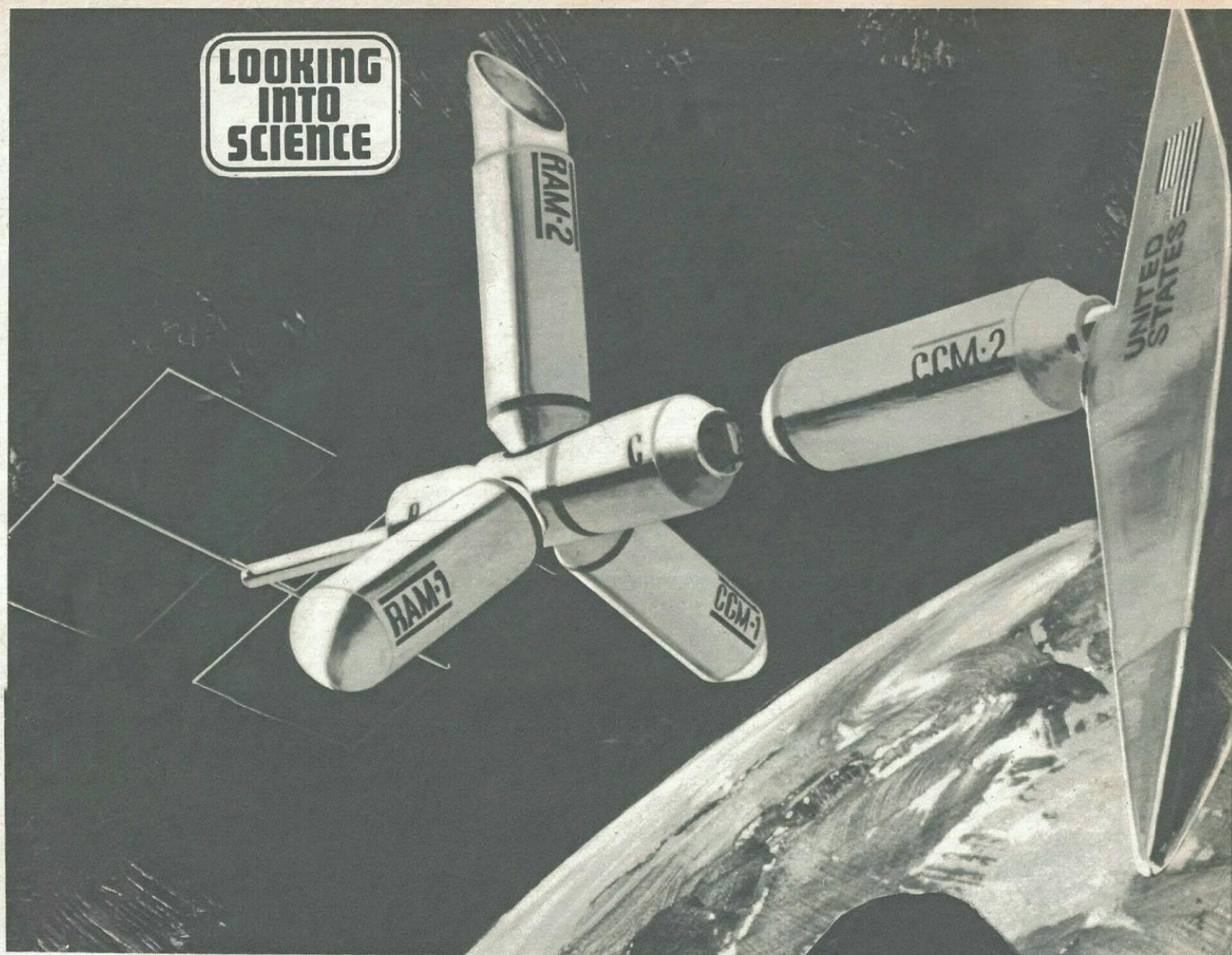


Top: fleets of satellites orbiting Venus could fire rockets to carry the seeds of the plant, Algae, into the planet's atmosphere. This would make oxygen so that Venus, eventually, could be habitable by Man.



Left: most sunshine is lost in space. To use this, space stations carrying mirrors could reflect the sun's rays on to solar power stations on Earth.

LOOKING INTO SCIENCE



RADAR TRACKS WINGED TRAVELLERS

Radar is being used in America to track birds as they fly on their migratory journeys. Two scientists of Cornell University capture the birds in nets.

One at a time, the birds are put in a specially-designed box and carried aloft by a weather balloon to an altitude of 3,000 to 6,000 ft.

The birds are released at a chosen altitude and are tracked by ground radar as they circle before deciding in which direction to fly on their migration. On the right is one of the birds being placed in the box before being carried into the air. In the centre-right is the balloon used for these experiments. On the far right is one of the scientists keeping a plot of the birds' travels.

Tracking is done by equipment lent by the National Aeronautics and Space Administration. The Radar used for this gives out a powerful, narrow beam from a 60 ft. diameter dish aerial. This echoes back from the birds and appears as a blip on a screen, which can be photo-

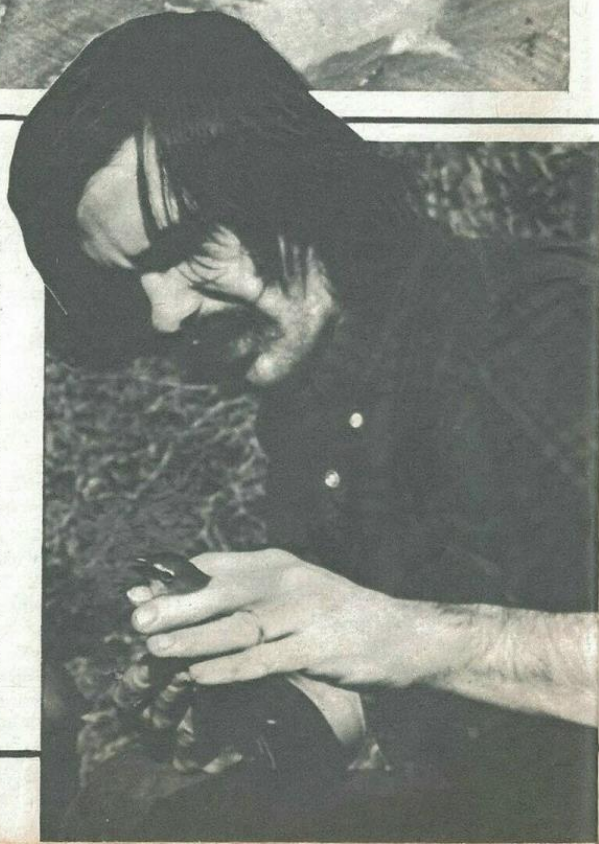
graphed to make a permanent record.

This will add to our knowledge of bird migration gained from a process called "ringing". Young birds, or older ones, caught in nets have a light band of aluminium placed on one of their legs. Birds ringed in Britain have an identification number and the words, "Inform British Museum. Nat. Hist."

With luck, some of these birds are found in other countries and the rings are posted to the Natural History section of the British Museum. The identification number gives the date and place of ringing so that the scientists concerned can be informed.

Why do birds migrate? It is sometimes said that they do so in order to avoid the cold of winter and the scarcity of food.

But this is only part of the story, for many birds start their journeys before the winter comes. The truth seems to be that many birds must migrate in order to survive, thus carrying out some mysterious plan of nature.



BOYS TELL THE WORLD OF RUSSIAN SPACE SCOOP

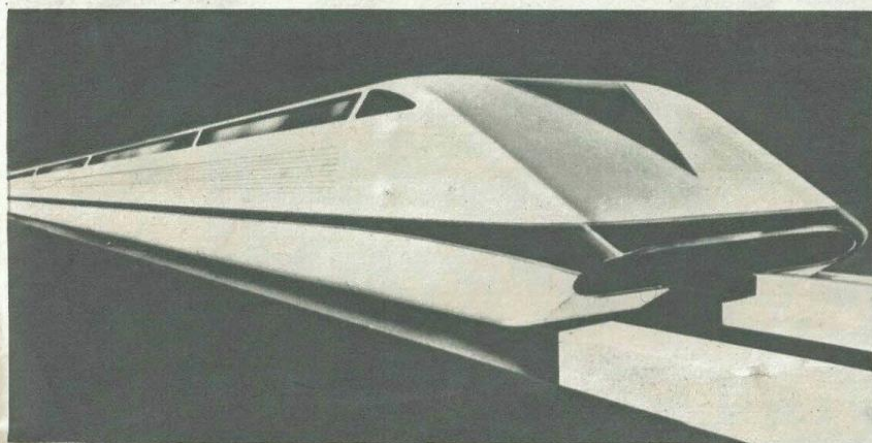
Grammar schoolboys listening to their short-wave radio heard a bleeping sound recently which they at once recognised. They had picked up a transmission from a Russian space craft and it told them that men were on their way to a history-making venture as the first occupants of an orbiting laboratory.

The world mourned when these men were found dead on the space craft's return to earth. Russia had already given a new zest to space research with the launching of Salyut, a space workshop, which could also be used as a stopping-off point for a tour of the planets in years to come.

America also has plans for a space station

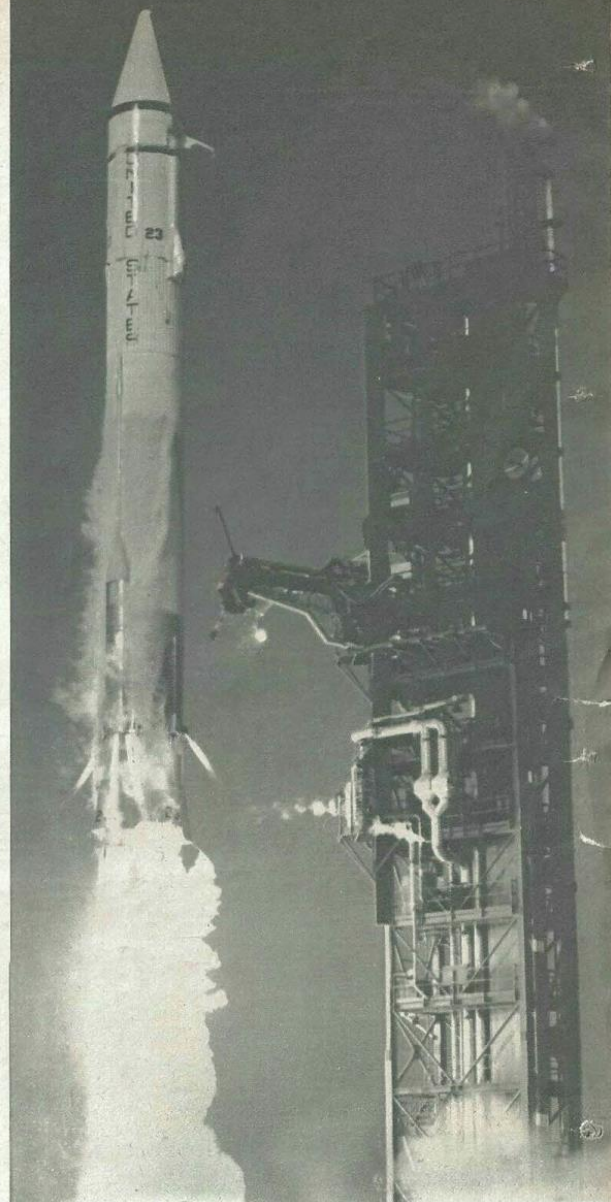
which would be sent up in sections and joined together in space. On the left is an artist's idea of what this would look like.

Each section would be taken into space by a device called a shuttle. In this picture, the shuttle (extreme right) is attaching the second crew section (CCM-2) to the parts already assembled. These are called modules and are the power module (you can just see the P) with the solar array (left), the core module (C) so-called because it is at the centre, the research applications modules (RAM-1 and RAM-2) where the scientific work will be done, and the other crew quarters (CCM-1).



THIS TRAIN 'FLOATS'

Train travel is fast—and getting faster—but even the speediest trains of today will be outdated by a special train being tested in Western Germany, of which an artist has made a futuristic sketch (above). This uses magnetism to hold the train a fraction of an inch above the track, to cut out friction. Magnetism also drives the train along, for a guide rail does the same job as the rotor in an electric motor.



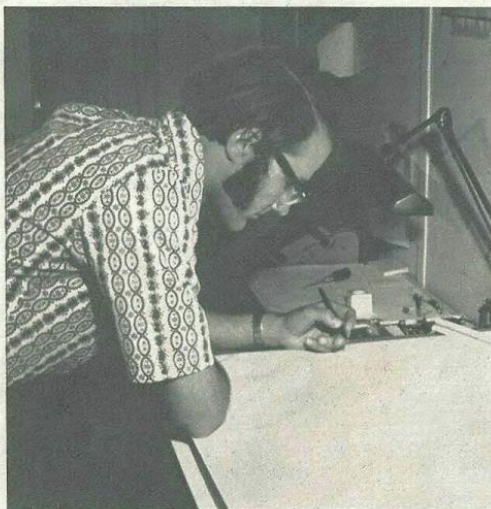
OFF TO MARS TO LOOK FOR LIFE

Off on a 167 days' trip to Mars is America's Mariner 9 rocket, which was launched from Cape Kennedy on 30th May. At that time, Mars was 63 million miles from earth. On 11th August, Mars will make its closest approach to earth—34.9 million miles.

Mariner's trip will cover 247 million miles in its arching trajectory to the planet. It will arrive at Mars on 14th November, when the planet is 75.5 million miles from earth.

This is only a small part of the space programme which, it is hoped, will bring reports from the surface of Mars in 1973.

These flight programmes give a new urgency to the task of perfecting devices for the detection of life, of signs of past life, and of conditions leading to the creation of life. Scientists want to find out how life really began and they believe that studies of other planets may give the answer.



The journeys of migratory birds are being plotted here from information received by radar in an American study of bird flight. Left: a balloon which carries the birds aloft for their release.



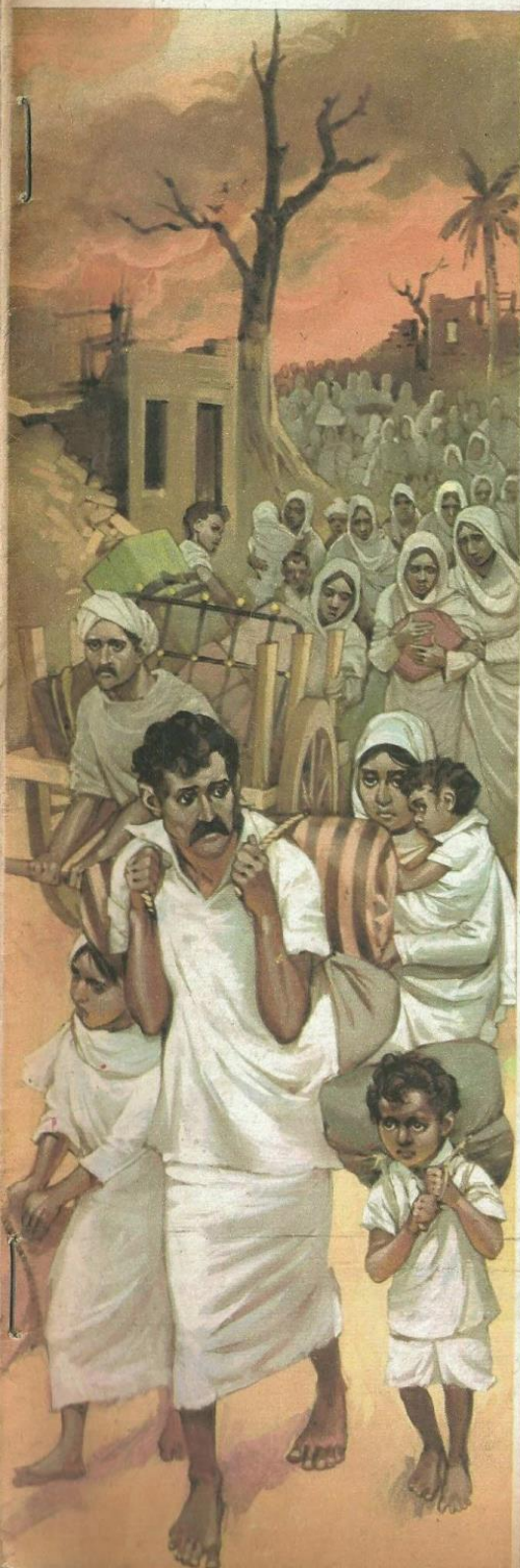
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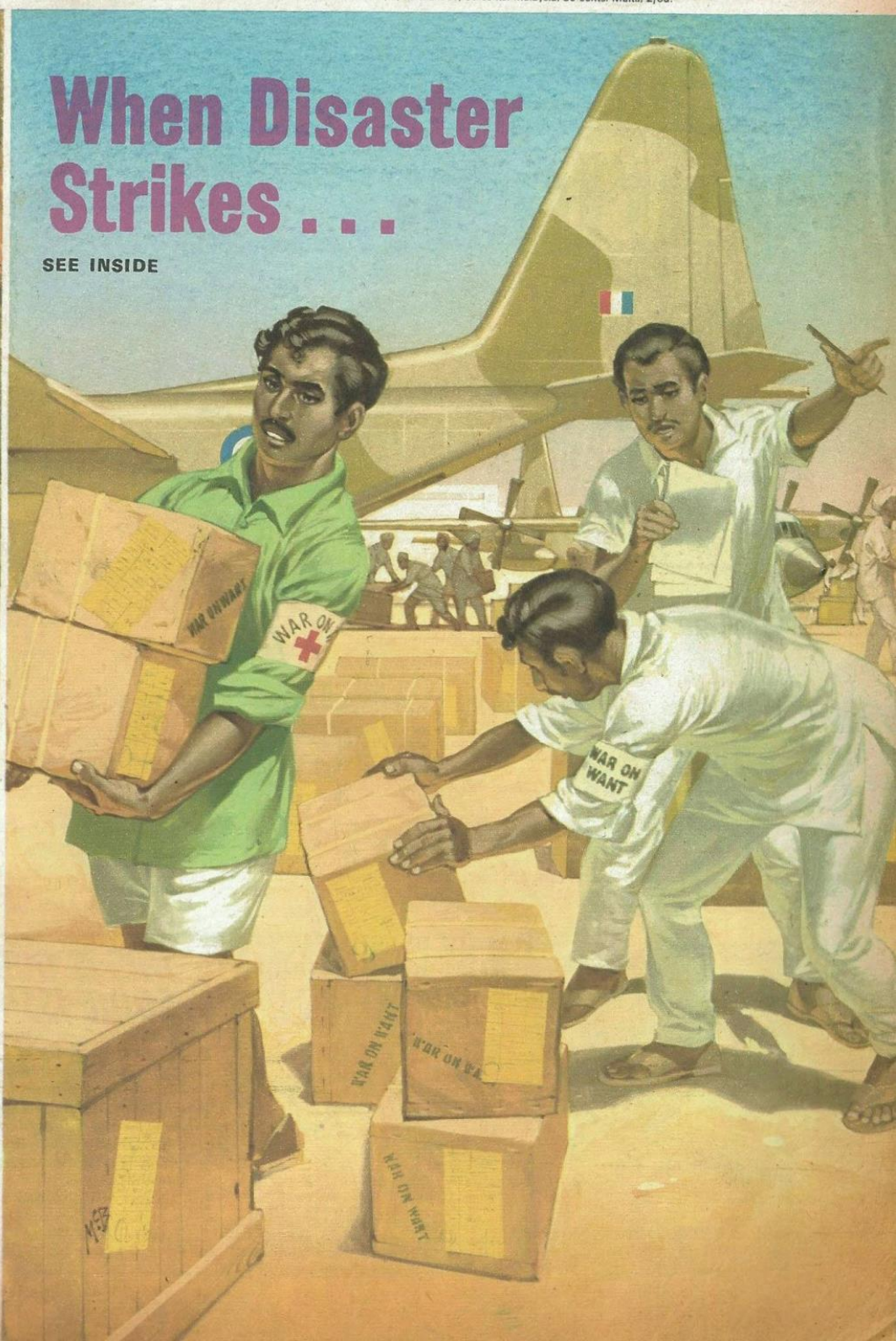
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When Disaster Strikes . . .

SEE INSIDE





THEY GAVE THE DESERT A 'GREENHOUSE'

Four hundred acres of Libyan dune desert has been sprayed with a flexible, synthetic rubber coating. It is protecting 60,000 eucalyptus saplings from powerful winds which tear away the top surface of the sand.

Five men, led by research workers from Britain finished the work 25 miles southwest of Tripoli in April. A special tractor-drawn spraying vehicle (top) covered the sand with a milky blend of latex and mineral oil.

When the team returned to check the progress of the plants (seen being planted on the right), they reported success. "The saplings are showing a high rate of establishment and we can expect a growth to 5 ft. or more within 18 months, if there are good rains next winter," they said.

The mineral sprayed was made by a Southampton firm, International Synthetic Rubber Co. Ltd.



LOOKING INTO SCIENCE

Some new ideas
from this
modern age



SAVING 'WASTE' IN SPACE

Shoot an enormous space rocket bigger than Nelson's column in London up into the atmosphere, and what have you got left when the mission is over? The capsule that brings the astronauts back to earth!

All the rest has been discarded in space. To save this waste, a space shuttle craft has been invented in America. This is a launch craft with a smaller vehicle on its back, which it can carry to heights of 200,000 ft. From here, the smaller vehicle can be easily launched into space.

Both craft can return to earth for re-use for up to 100 missions, thus making a big saving in space vehicles.

Among the uses for the shuttle, is the running of a "bus" service to take men to and from orbiting space

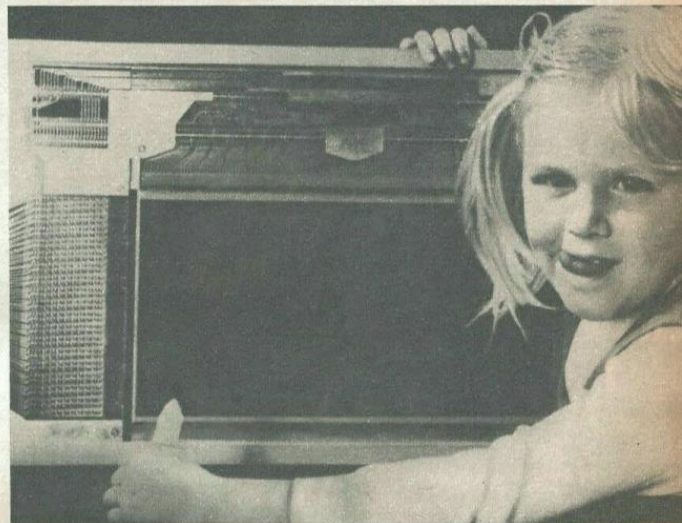


laboratories, such as Russia has now launched.

On the right is a shuttle craft design worked out by Grumman and Boeing, leaders in American space travel development.

THE MEMORY THAT CAN'T FORGET

Seen right is a new kind of memory unit for a computer. It can "remember" 74,000 things stored on a mass of very fine wire. An advantage is that it uses very little electricity, can keep its memory for as long as necessary and can produce the information at great speed.



STORING OIL

Oil pumped from oil fields beneath the sea off Indonesia will be stored in a tank like this (above) made by a Japanese company. When full, the vessel will be towed to oil tankers which will take the oil away. Finishing date: June, 1972.



TWO WAYS TO BEAT OIL POLLUTION

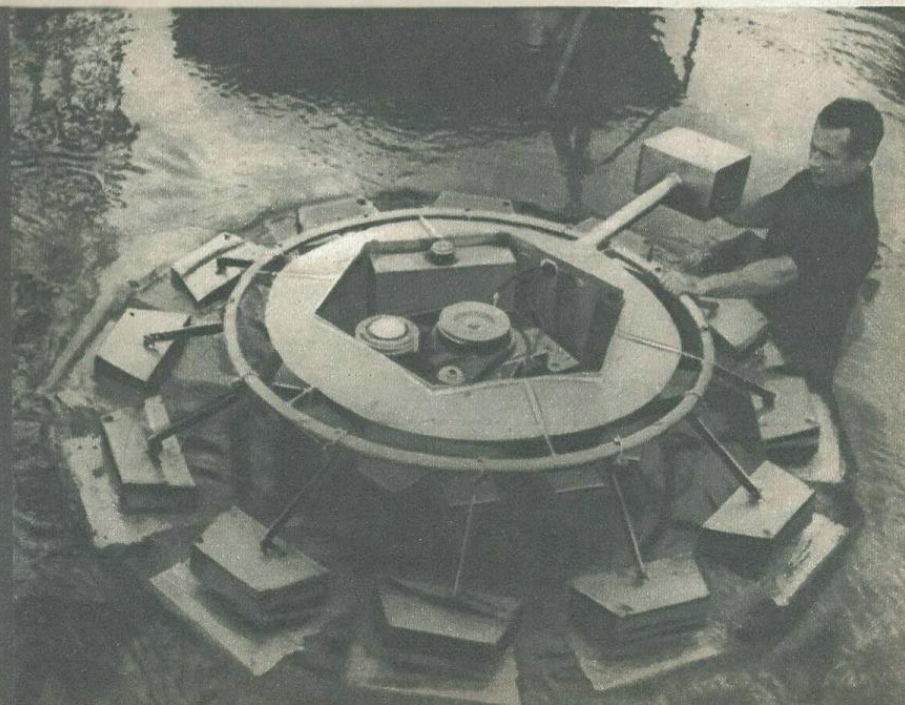
A new device to clear oil from the surface of the sea (right) has been shown at Port Everglades, Florida, U.S.A. Called a "Medusa oil collection system" (Medusa was a Greek mythological monster with snakes for hair), it sucks the spilled oil from the surface. It separates the oil from the water and pumps it into containers.

The one in our picture is a small model which can deal with 1,100 gallons a minute, but the largest can cope with 10,000 gallons.

Light enough to be dropped by helicopter, the Medusa can quickly be flown to any troublesome area.

On the left is a Japanese answer to oil pollution. This is a "fence" which has been tried out at a port where tankers berth to empty or fill at an oil refinery. It is fixed to the sea bed and raised by compressed air to keep any floating oil in a restricted area, so that it can be later removed.

Being extremely tough, the fence can stand up to strong winds and powerful waves. This is better than the conventional oil fences, which are towed around by oil tankers.



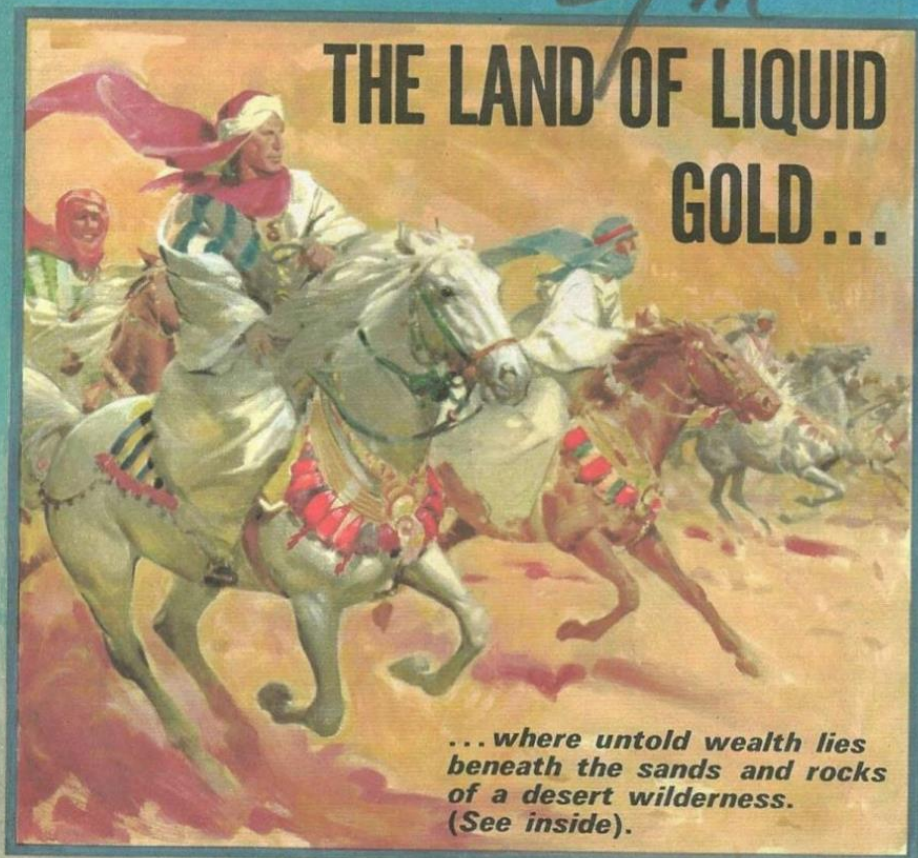
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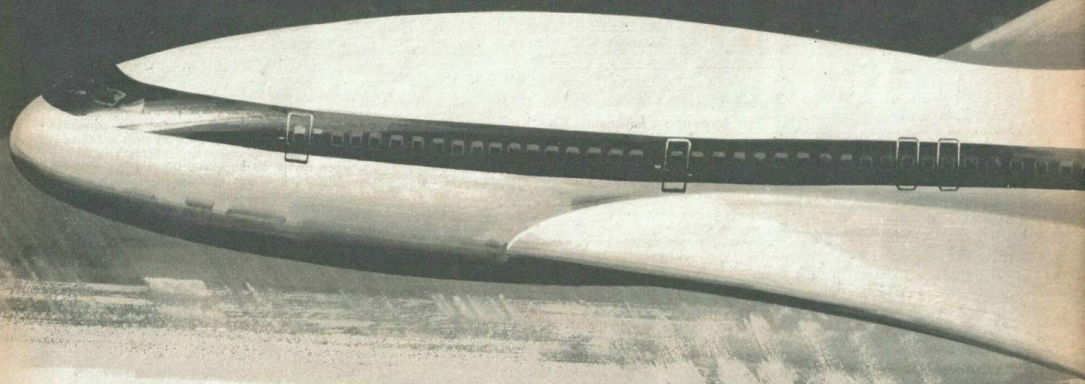
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THE SHAPE OF WINGS TO COME



RADAR THAT THINKS FOR ITSELF

THE world's busiest airport in terms of total aircraft movements—take-offs and landings—is Chicago's O'Hare. Besides handling commercial airliners, this has a mass of small, private business planes to deal with.

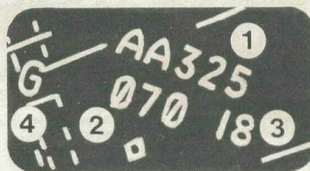
The air traffic controllers who shepherd these flocks of high-speed aircraft have been given a powerful ally to help make their job easier.

Known as ARTS-3 (Automated Radar Terminal System-3), the installation is a combination of powerful Radar and computers, now set up in the new control tower at O'Hare. It is expected to be in use soon. Here is how it works.

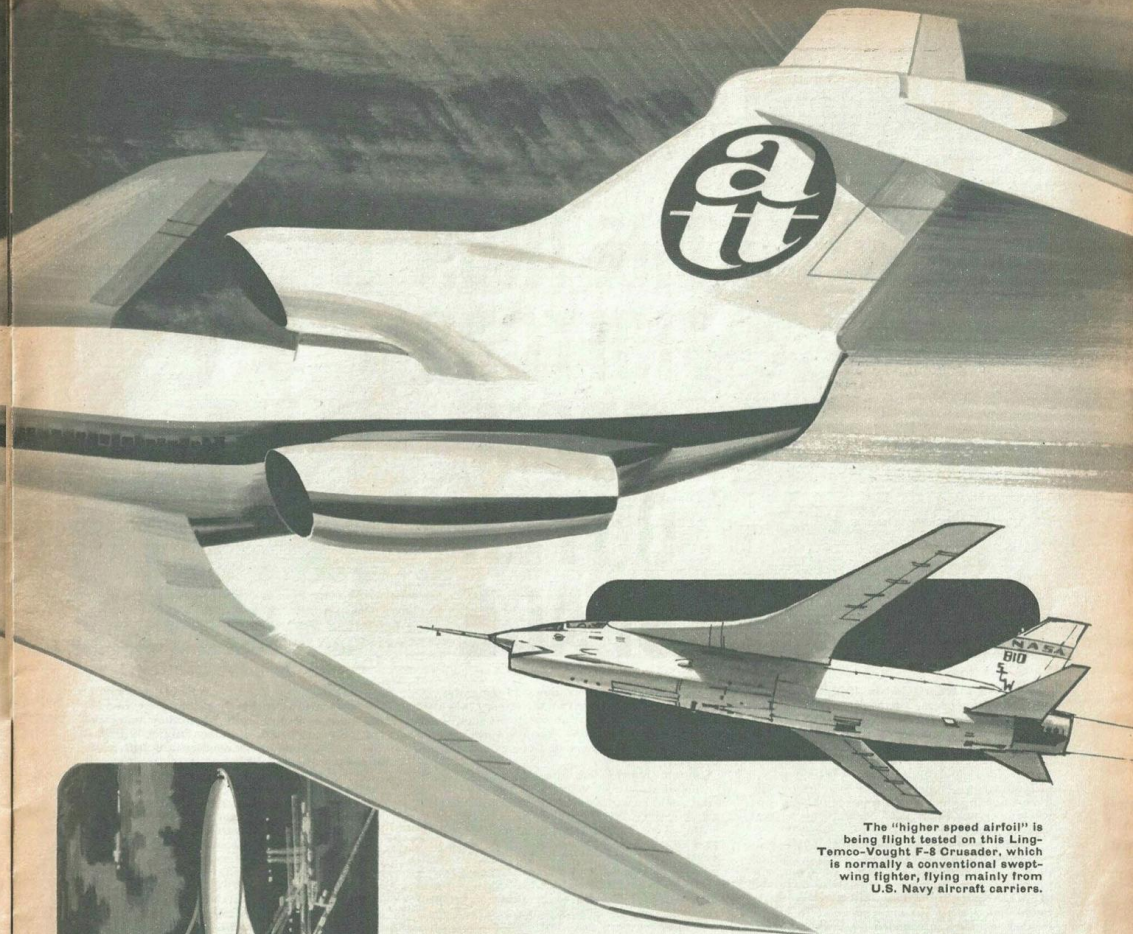
The Radar scanners sweep the sky to pick out aircraft at 60-100 nautical miles range. It triggers off a device on the aircraft which sends back its identity code, height and computed ground speed.

This information is presented to the controller on his screen. He is also helped by a computer which works out a plan for helping the approaching aircraft to land, or for controlling the take-off of departing aircraft.

The controller, by pushing buttons on his console, can instruct the Radar to add further information needed to assist the aircraft.



Controllers at work in the Chicago O'Hare installation. Inset (left) is a small section of one of the screens showing: 1. Aircraft identity. 2. Altitude in hundreds of feet (7,000 ft.) 3. Computed ground speed (180 knots). 4. The controller's identity symbol.



The "higher speed airfoil" is being flight tested on this Ling-Temco-Vought F-8 Crusader, which is normally a conventional swept-wing fighter, flying mainly from U.S. Navy aircraft carriers.



Above is a plan view of the "att" design. From this angle, the unique shape of the "higher speed airfoil" can be seen. The bulged shape of the fuselage increases the aerodynamic efficiency of the aircraft and allows more passenger room and cargo space.

THE letters "att" on the tail fin of the graceful bulbous aircraft racing across the top of these pages stand for "advanced technology transport". This is a massive research project being undertaken by the National Aeronautics and Space Administration of America. Three of the world's most famous commercial aircraft builders are working on the project with NASA—Convair-Aero-space, Lockheed-Georgia and the Boeing company.

This picture shows just one of about 500 different size, shape and engine layout designs produced by Convair Aerospace. In the next few months, their mass of engineering ideas will be whittled down to four basic designs in the 200-400 passenger size range. All the skill of their designers is being focused on ensuring that the speed, range and payload of America's next generation of subsonic airliners will be better than those of any other nation in the fierce competition for sales to airlines in the 1975-1985 period.

The centre of the effort is the so-called "higher-speed airfoil", previously known as the "super-critical wing". This, it is hoped, will be so efficient in flight that it will raise the cruising speed of airliners using it to 660 mph at 40,000 ft. Not only will planes be able to fly for long distances at that speed, but their costs will be lower.

The basic shape of this beautiful wing can be seen

in our pictures. The fuselage will also be shaped to squeeze the last ounce of efficiency from the design. The bulged shape is known to aerodynamicists as "area ruling." Its function is to smooth the airflow past the body, so cutting turbulence and reducing drag.

Wing, fuselage and engine nacelles will be blended to form a beautiful shape which slips easily through the air.

The sharp, jutting forward slope of the air intakes is designed to feed air smoothly into the jet engines, even when the aircraft is ascending or descending steeply at take-off and landing.

Much attention is also being given to cutting down engine noise, news which will be welcomed by those who live near airports.

A recent survey showed that commercial flights in America carry about 119 million passengers a year. A big rival to the airlines are light aircraft run by business concerns and private people. Already, these carry about 100 million people a year, and this total is expected to grow to 317 million by 1980.

This will lead to a demand for even better light aircraft. In ten years, the present fleet of 122,000 private aircraft will have doubled and there will be 1.4 million pilots, as opposed to 617,000 today.

Designers are expected to concentrate on developing both turbo-prop and pure jet planes for private use.

A LOOK INTO THE FUTURE by CHARLES HATCHER B.Sc.

A.D. 2001

HOW WILL WE LIVE?

IN 30 years time most of you will be married and living in your own homes. Your children will be going to school.

What will life be like in the year 2001? What kind of homes will we live in? What will our schools be like? What sorts of food will we be eating? What strange styles of clothing will we be wearing? Will we still be wearing long hair or short hair? Will we still be using decimal currency?

It is difficult if not impossible to give very accurate answers to questions like these. We can, however, make fairly intelligent guesses about life in 30 years' time. We can do this by thinking about the advances in science and industry which have occurred in the 30 years which have passed. We can also make reasonable predictions about the future by considering the kind of life we have today.

We can begin by being reasonably certain that most homes will be centrally heated in 2001. Thirty years ago most people used to heat their homes by having a coal fire burning in a grate in each room. Fewer people used gas or electric fires in much the same way, which was more expensive than just using coal.

Today more and more new houses and flats are being built which have central-heating. There are many gas and electric fires still being used, but these for the most part are of a modern kind which warm the air in the room, rather than just giving off a friendly glow which in very cold weather makes us too warm in the front and leaves us too cold in the back! And the coal fires still being used burn the new smokeless fuels which are also designed to warm the air.

It now seems unlikely that future homes will use central-heating which relies upon coal or gas, or even mains-electricity. We are already finding that supplies of coal, gas and oil are rapidly diminishing. It is likely that we will become more and more dependent upon atomic energy.

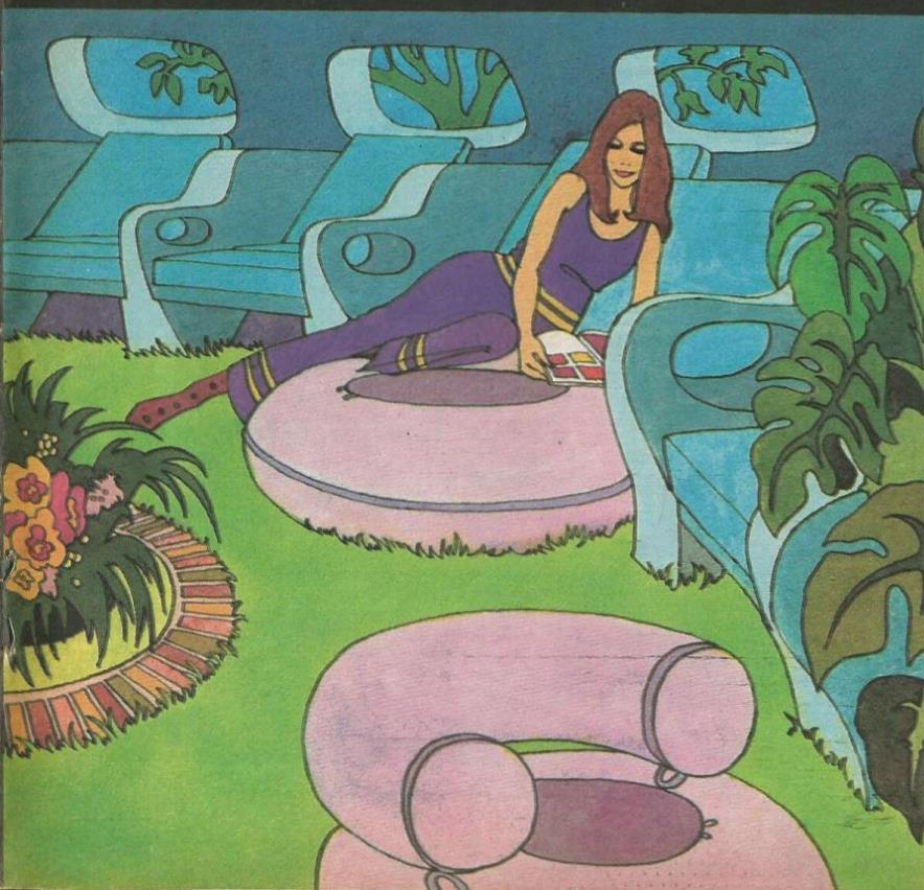
Many large blocks of flats will have a *nuclear reactor* or "atomic furnace" placed in the basement, surrounded by a "shield" made of sheet lead and thick concrete.

This form of dome has already been put to use in the building of temporary aircraft hangers and exhibition sites. Who knows? Before many decades have passed we may be buying our houses in do-it-yourself packs, and erecting them ourselves!





Perhaps the cry "My feet ache!" will disappear from the lips of the woman of 2001, when she can use a video-phone like the one shown here to do her shopping.



Above: parcels packed in polythene could be blown down a central pipe by compressed air. This delivery system is already being used in Paris for letters. Left: a lawn instead of a carpet on the living-room floor might be a reality in the future.

This will protect people living in the ground floor flats from radioactivity.

These furnaces, of course, will be completely automatic, only needing attention every 10 years or so, when their uranium "fuel rods" need replacing. And in the "luxury flats" of 2001 there will be no need to regulate the heat by twisting a knob on a living-room wall. We will be able to "programme" our individual heat regulators by pressing a long row of numbered buttons. Our instructions for doing this will be given to us when we watch long-range weather forecasts on TV. Perhaps we will be able to arrange our heating requirements for a whole year in advance. But we will have to assume that weather forecasting in 2001 will have improved!

Today modern building makes use of steel, concrete and special plastics. Walls, ceilings and floors are "pre-fabricated" in special factories, and then assembled on the building site in a few weeks.

Future buildings could be made entirely of plastic or plastic reinforced with materials like glass fibre or metal screening. These special plastics would be actually made on the building site itself and piped into huge moulds formed into the exact shapes of the walls, floors and ceilings of the building being constructed. These moulds would be made of thin rubber or plastic. Air under pressure would be used to "blow up" these huge moulds like balloons. Once the plastic had hardened, these inflatable moulds could then be "deflated" and moved away to a new building site.

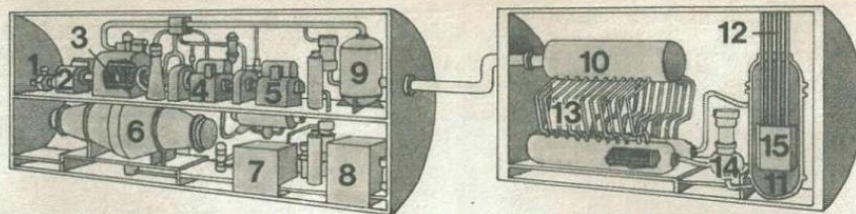
Floral floors

Individual homes, particularly those built in the country, would be designed to fit in with natural surroundings. Imagine huge domes made of lengths of thin yet immensely strong and light metal. A number of domes could be placed right over lawns, trees and gardens. Large sheets of completely clear polythene placed over the domes would keep out the wind and the rain yet let in the sunshine. Areas of opaque plastic sheet, arranged like blinds, could ensure privacy. In this way we could enjoy life with flowers growing out of the floor of the living room!

Even today this idea is being used for building temporary aircraft hangars and exhibition sites. The "geodesic dome," as it is called, will be a standard piece of building equipment in the future.

The kitchens and bathrooms of the future will be made in one piece, shaped from sheet plastic or stainless steel in one blow from a huge moulding press. Smaller units like taps, handles, stove burners, pipes and electric wires, would all be added after the main units had been installed.

HEATING FOR THE HOME



BOILER ROOM

- 1 Clutch
- 2 Reduction Gear
- 3 Main Steam Turbine
- 4 Turbine Generator (for pump)
- 5 Turbine Generator (Ship's power supply)
- 6 Main Condenser

- 7 Drain Tank
- 8 Feed Storage Tank
- 9 Steam Separator

REACTOR ROOM

- 10 Non-radioactive, low-pressure steam
- 11 Hot, radioactive water under pressure
- 12 Control rods
- 13 Steam Generator
- 14 Pump
- 15 Uranium Core

The food we will eat in 2001 is unlikely to be much different from the food we eat today. It will, however, be easier to prepare, and it will be healthier. But we should not worry—we will still be able to look forward to fish and chips, baked beans on toast and fresh green salads.

Chemical menace

Even today scientists are becoming increasingly worried about the health hazards caused by chemicals used as fertilizers on farms and in the preparation of tinned foods. Many of the special chemicals, called "pesticides," used to protect growing fruit and vegetables, have now been found to be dangerous.

Ways will be found of producing fresh food safely. Ways will also be found of getting fresh food to our homes without having to bottle or tin it, or destroy much of its taste by freezing it.

Naturally-dried fruits and vegetables have been found to be quite healthy today. Various fruits and vegetables like dried onions, mushrooms, and peas, with water added to them, can be difficult to distinguish from the fresh variety. In 2001 a complete meal will be available in dried form, stored ready for use in "throw-away" plates and bowls. Dried foods can be kept for years in moisture proof containers.

The schools of the future will probably not be actually called "schools" at all. They will probably be named "learning laboratories." Classes as such, with 30, 40 or even 50 pupils sitting dutifully in front of a teacher, cramped uncomfortably behind hard desks, will hardly exist. There will be about six pupils to each teacher.

There will be far fewer school books. Instead we will use TV and film programmes, gramophone records and tape recordings. Instead of writing reports and essays we will record our own voices on tape. School plays can be recorded on "video-tape". Exercise books will be replaced by "teaching machines"—intriguing metal boxes containing buttons to press and a TV screen to watch. These teaching machines will be

fun to use. Our children will ask themselves questions by pressing buttons and see the correct answers as interesting pictures on the screen. Mathematics, science and geography will be learned by making models. All this is bound to happen because some of it is being done in many schools today.

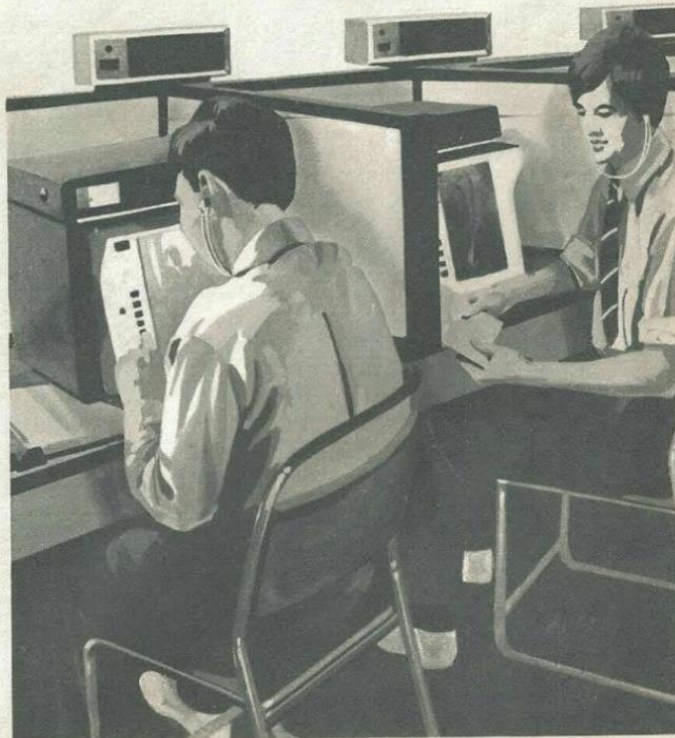
We will certainly use the decimal system in 2001—but we are unlikely to actually use money very often. Most of the things we buy will be ordered from huge department stores and supermarkets by simply dialling a long code number on the telephone. The number will be found by consulting an illustrated catalogue, looking very much like a very fat telephone directory. After dialling, a picture of what we have ordered will appear on the screen of the "video-phone". In the store or super-market our purchase will be recorded on a computer, which

will issue orders for delivery to our home.

In fact our purchases might not even be delivered by lorry or van at all. In the cities and larger towns special pipes running just under the streets will carry goods from the stores to our homes. Things we have bought will be packed in plastic containers, and "blown" through the pipes to our homes by compressed air. Today this particular method is being used in Paris to send letters quickly to various parts of the city.

How will we dress in 2001? Who knows? Today we are wearing so many different styles, particularly from the past, that 2001 fashions could well be anything, from space-age plastic overalls to Regency frills.

And in 2001 we will be doing a great deal of travelling—but this is something we will be talking about in part two of this series.



Teaching machines may one day replace exercise books.

LOOK LEARN

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No. 506, 25th SEPTEMBER, 1971

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FREE INSIDE!

The first 32 pages of Your Look and Learn BOOK OF RECORDS

*The World's Fastest, Largest, Smallest, Greatest
and Funniest.*





THE TRAIN THAT'S ALWAYS THERE

Here's the travel dream of tomorrow. It never stops, it's never late and there is always room for more passengers.

WHETHER travelling by bus, underground or train, getting around our crowded modern cities is becoming more and more difficult. After risking life and limb scrambling down escalators and stairs we arrive on the platform just as the train doors are closing. We wait and wait and the next train never seems to arrive. Yet when it does it is so crowded that we can barely squeeze into a carriage. And how often have we stood impatiently at a bus stop in the pouring rain, while buses pass by that are so full-up that they just cannot stop to let us on?

Modern transport engineers have now found what they believe is the ideal cure for our travelling headaches: a train that is always waiting for you in the station and yet is always on the move at the same time!

If you think a train like this is a complete impossibility then a quick look at our artist's sketch, and the diagram, should set your mind at rest. The 'train' which the engineers have in mind is not strictly a train at all: it is a continuous moving belt similar in principle to the 'moving pavements' which are now being used in some American cities. The engineers also got their idea from the conveyor belts used in motor car factories which keep the car chassis constantly in

motion while the various parts are being attached to it. Because of this the engineers have named their invention the Conveyor Train.

This is what happens when you take a ride on a conveyor train. You go up into the station by means of an escalator. The station itself is perched on huge metal 'legs.' Under the station is a restaurant where you can have a cup of tea and wait for a friend who might be travelling with you.

ARMCHAIR RIDE

The station is large and roomy and you can look out on to the busy city street through huge curved windows. After buying a ticket from a slot-machine you walk up to the moving belt, which is about as wide as an average living room and covered with a non-slip rubber floor. On the floor you see a number of comfortable armchairs. All you do now to board the conveyor train is step on to the moving belt and sit down in one of the chairs. Doing this is by no means dangerous, because the belt moves slowly enough to enable you to board the train without stumbling, and yet it moves fast enough to get you to your destination in good time. The

engineers have found that a speed of just about 10 miles per hour will allow the conveyor train to operate efficiently.

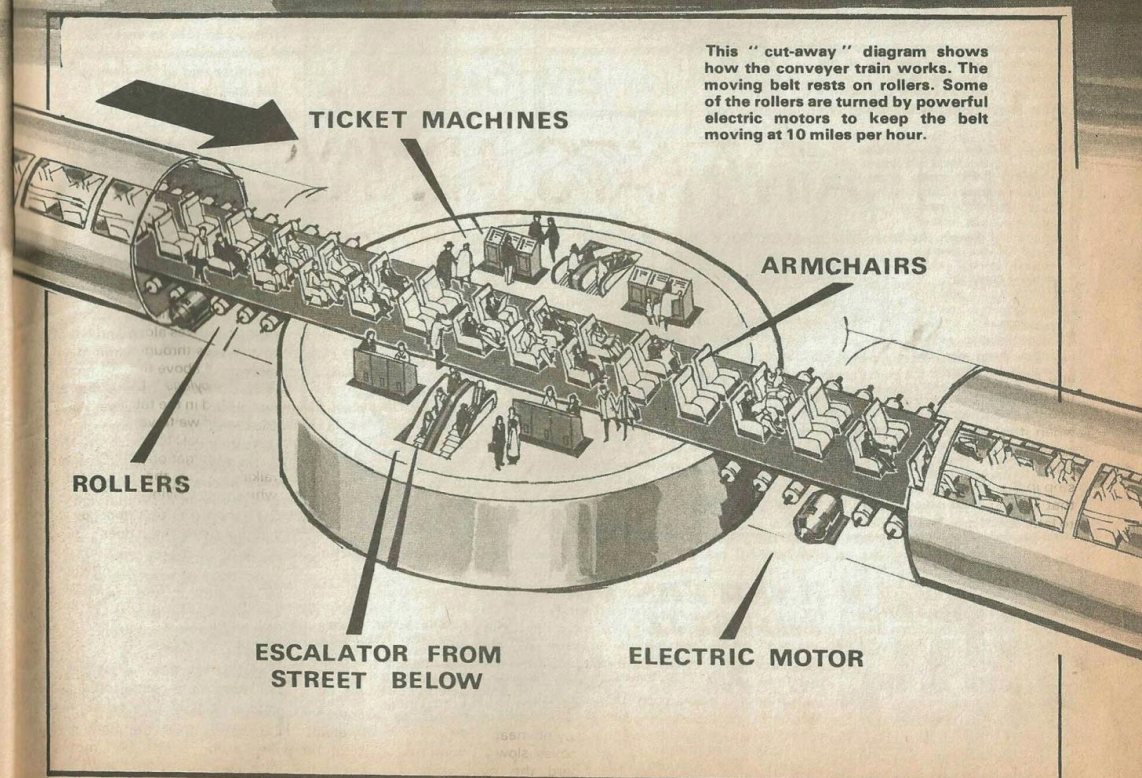
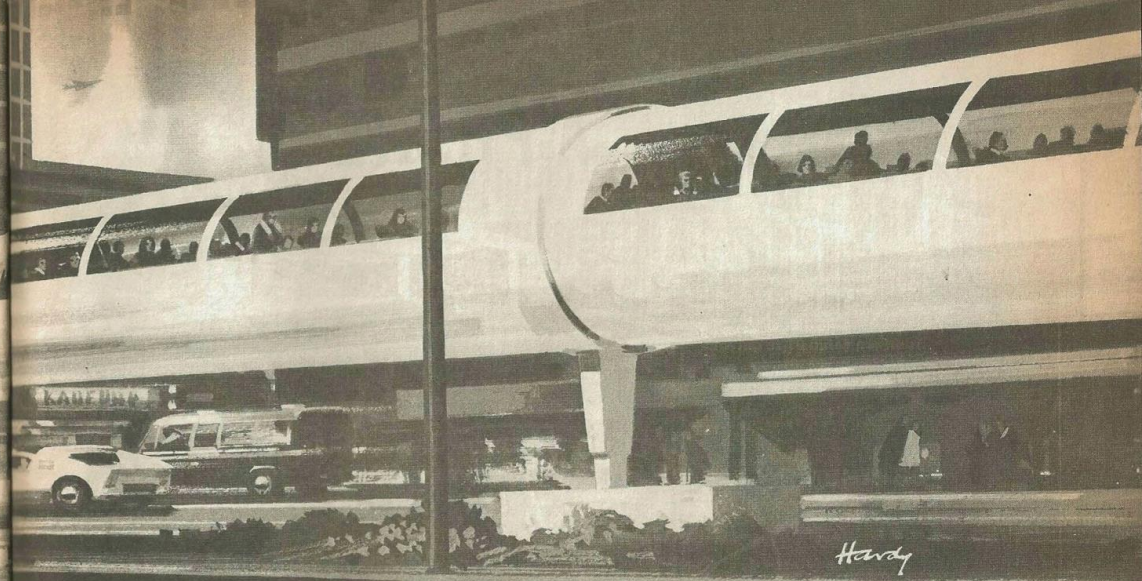
The conveyor belt moves along and out of the stations and passes through large metal tubes which are raised above the city streets by steel 'legs' or pylons. Large curved plastic windows placed in the tube walls give us a view of the city as we travel.

Another very unusual thing about the conveyor train: you can get out of your chair and start walking along the belt in the direction in which it is moving. In this way you can achieve the impossible too: get to your destination before the train does!

The first city in the world to become the proud possessor of a conveyor train is Munich in Western Germany. The German engineers who are designing and building it there estimate that by 1976 it will be in full operation.

Look at the diagram: it explains exactly how the conveyor train works. The rubber-floored belt rests on a series of rollers. Powerful electric motors are placed at intervals along the length of the tubes and keep the rollers turning. The belt moves because it is in constant contact with the rollers.

MORE SCIENCE ON PAGE 44.



LOOK LEARN

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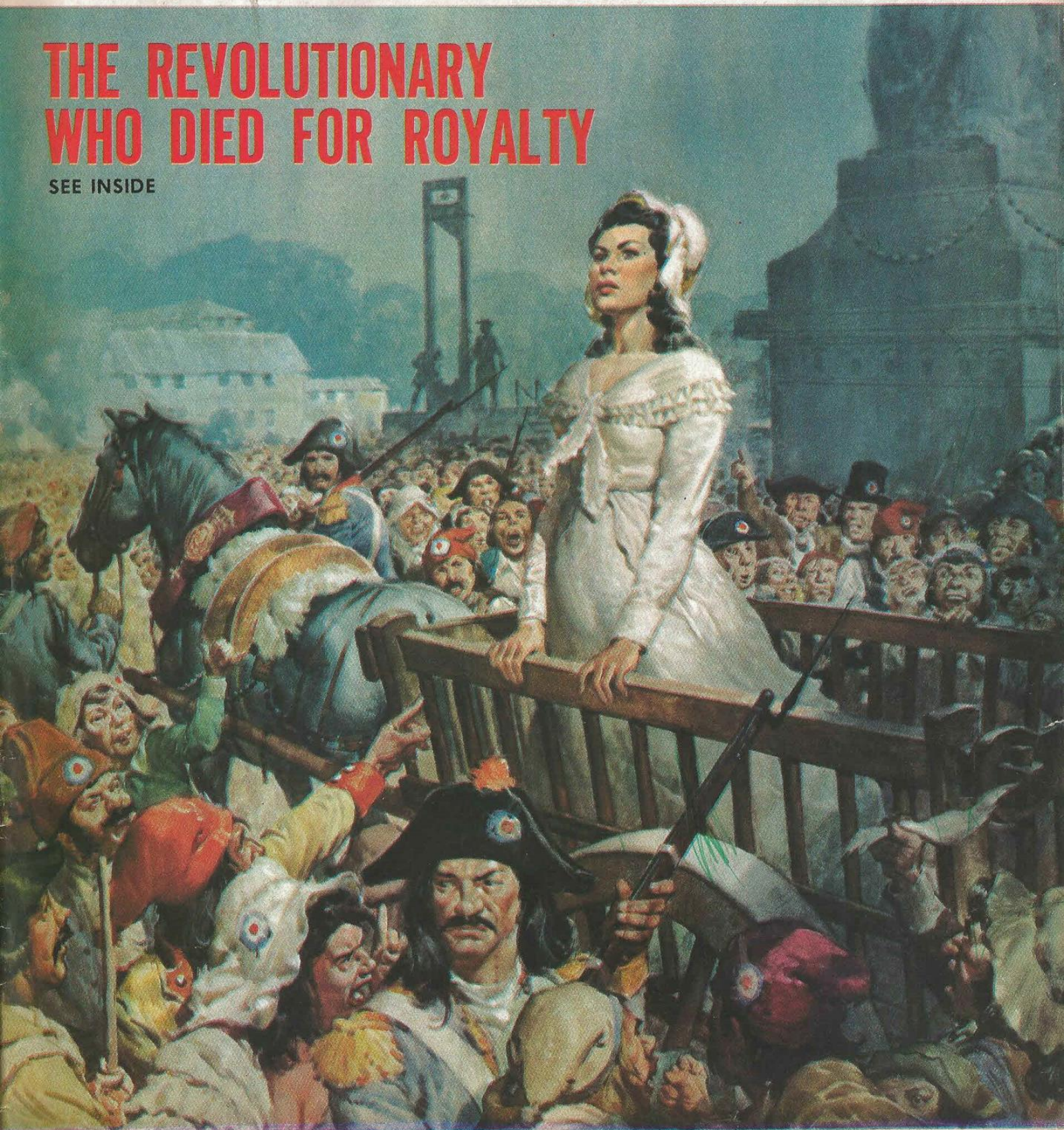
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THE REVOLUTIONARY WHO DIED FOR ROYALTY

SEE INSIDE



LOOKING INTO SCIENCE

THE MOON'S MINI-MOON

THE launching of a satellite into orbit is an awe-inspiring sight. As the final count-down proceeds the technicians scurry around making last-second preparations, looking like flies against the towering booster rocket. The rocket "skin" is crusted with frost and thin wisps of white vapour lazily drift up into a cloudless sky.

Then, suddenly, the launch-pad seems to erupt in a thunderous roar of fire and smoke. The rocket rises so slowly that we imagine it is trying to pry itself away from the ground...

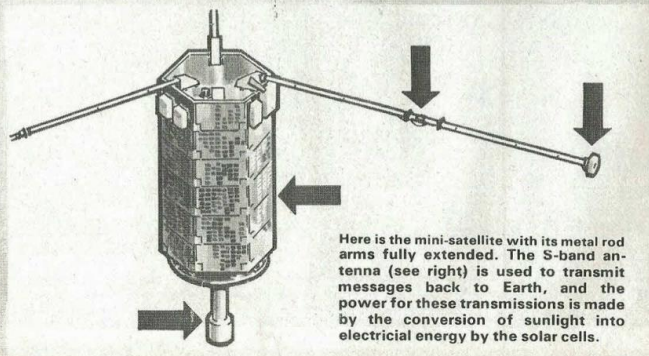
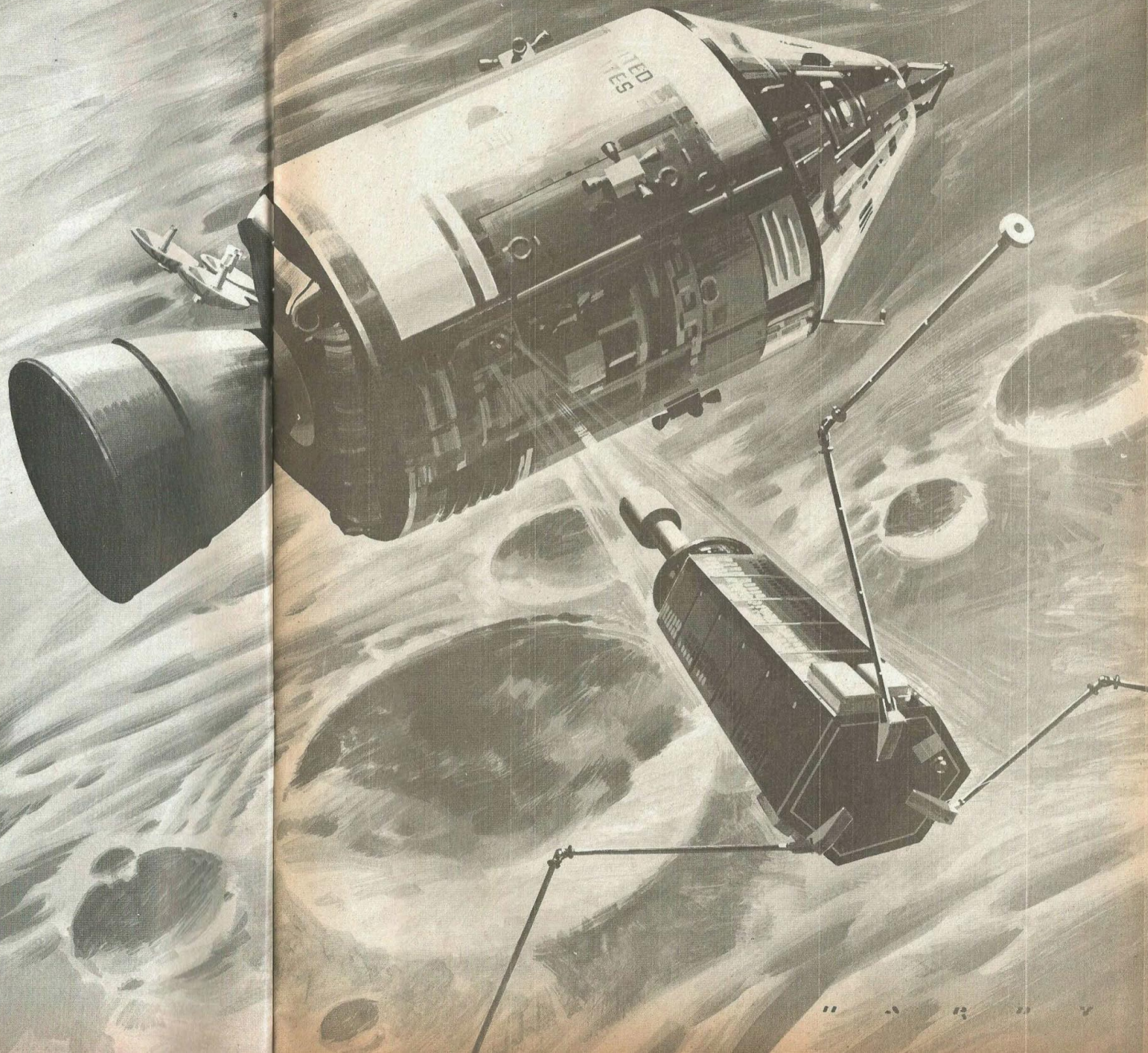
Yet by comparison the first launching of a satellite from a space ship orbiting the Moon seems almost an anti-climax.

□ The date was August 4th, 1971, and the three Apollo-15 astronauts were waiting in

the cone-shaped Command Module. In exactly one hour and eight minutes they were to ignite the main rocket engine which would pull them out of their Moon orbit and send them on their return journey to Earth. When the time came, the command module pilot, Astronaut Alfred M. Worden, pulled down a switch on the instrument panel. At first nothing much seemed to happen — all they heard was a faint "zing" as if an alarm-clock was getting ready to ring!

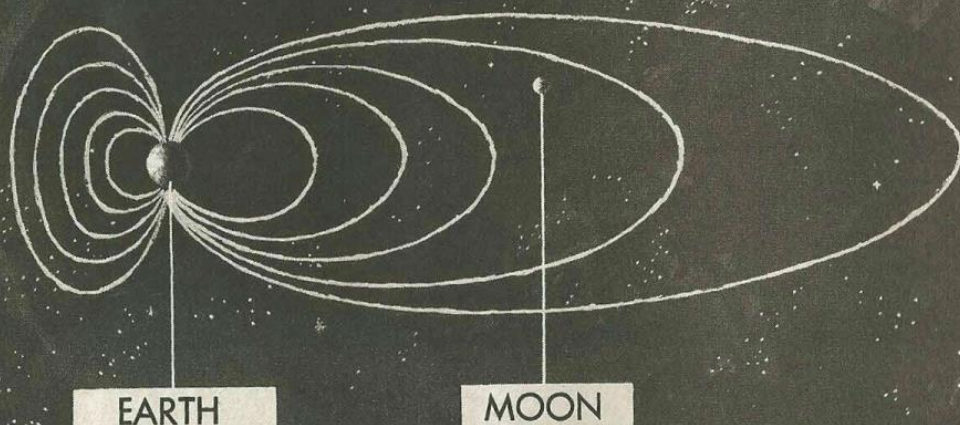
But from the Service Module attached to their ship an object about the size of a suitcase shot silently out into space, driven by a strong spring which had been auto-

CONTINUED ON NEXT PAGE



Here is the mini-satellite with its metal rod arms fully extended. The S-band antenna (see right) is used to transmit messages back to Earth, and the power for these transmissions is made by the conversion of sunlight into electrical energy by the solar cells.

THE SUN'S 'WIND'



matically released when Astronaut Worden pulled the switch.

The object, an eight-sided affair covered with glittering "solar cells" the size of postage stamps, was spinning around and around some distance away. And, like the legs of some strange insect, three slim metal rods seemed to "uncoil" themselves from it.

The astronauts checked their instruments. It was a successful launch, achieved without noise, fire or smoke.

An hour later they were on their way to Earth. Behind them the Moon's first "mini-moon" stayed in a two-hour orbit, seventy miles above the Moon's surface.

It will stay in its new home for at least a year, doing a special job for scientists back on Earth, who receive hourly "reports" from its built-in radio transmitter powered by electricity from the Sun's rays shining on its solar cells.

After a year, its mission accomplished, it will gradually "stray" from its orbit and go crashing down on the Moon's airless surface.

SUN STORMS

To be caught in a hurricane here on Earth can be a terrifying experience — the winds howl and mountainous waves threaten to send even the stoutest ship to the bottom.

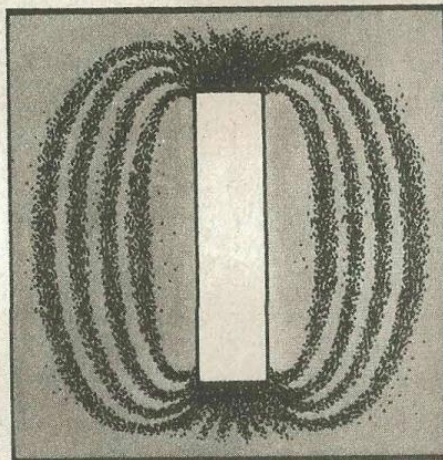
A hurricane in outer space rages with even more power than it does on Earth, yet nothing is heard or seen. Millions upon millions of invisible atomic particles are constantly "blowing" out from the distant Sun — during "calm" periods this "solar wind" rushes towards the Sun's family of planets at speeds of a few hundreds of miles an hour, but during "solar hurricanes" these winds storm against the planets at speeds of thousands of miles an hour.

Studying solar storms is just one of the important jobs the mini-satellite will do.

On Earth scientists study the winds by sending up balloons, watching how and where they are blown about. But the mini-satellite will investigate the solar winds by a most unusual method.

Attached to the end of one of the satellites

Above: The Earth's magnetic field looks like this — blown sideways by the atomic "wind" from the Sun. Below: This is the way we see the field of a magnet, using iron filings.



three un-coiled "arms" is a scientific instrument called a magnetometer, which can detect and measure magnetism.

A magnetic field surrounds the Earth, which is itself a magnet. Magnetic fields were first discovered by simply scattering iron filings on a sheet of paper placed over an ordinary magnet. The filings "line up" along the magnetic field, which stretches from the so-called "North Pole" of the magnet, to the "South Pole" of the magnet.

If we could fill the space around the Earth with iron filings the Earth's magnetic field would show up in the same way. But there is one important difference, however.

Look at the two diagrams above.

The smaller diagram shows what the magnetic field around an ordinary bar magnet looks like using paper and iron filings.

The larger diagram shows the magnetic field around the Earth. But notice the important difference — on one side of the Earth the field seems to be strangely

"pressed up" against the Earth. Yet on the other side the field tapers away from the Earth to form a gigantic "tail" stretching many thousands of miles away into space.

The "wind" coming from the Sun actually "blows" the Earth's magnetic field out of shape in this extraordinary fashion.

HURRICANE

The best way, and perhaps the only way to study the Sun's "wind" is to study what this wind does to the magnetic field of the Earth — how the wind "blows" it about and alters its shape.

The mini-satellite will do this, while it is in orbit around the Moon, using its magnetometer. This instrument will keep measuring the Earth's magnetic field, from a "Moon distance" — and all these measurements will be sent back to Earth by radio.

Here on Earth our atmosphere protects us from the solar wind. But around the Moon, where there is no atmosphere, the solar storms rage with full force. For this reason "hurricane spotting" is best carried out around the Moon.

The reports coming from the mini-satellite should answer a number of questions Earth-scientists are asking themselves about the solar-winds and the magnetic field around the Earth.

For instance, what exactly happens as the Moon moves around in the Earth's magnetism? What happens to the solar "hurricanes"?

Has the Moon a magnetic field of its own? If so, how does it "share" its magnetic field with the Earth's?

And there is one question which our readers are probably asking at this point:

How do Earth scientists get radio reports from the mini-satellite when it disappears around the "blind side" of the Moon?

There is a simple answer to that. During this period of radio "blackout," which lasts about 45 minutes during each two hour orbit, radio reports will be recorded on magnetic tape. These will then be sent to the Earth when the satellite re-appears again and radio contact is restored.

LOOK AND LEARN

No. 514, 20th NOVEMBER, 1971

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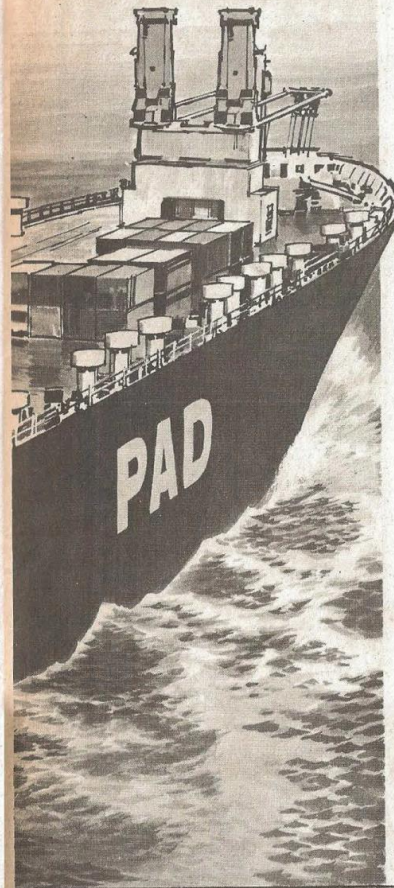
**KING
HARRY
FOR
ENGLAND!**

SEE INSIDE

DAN ESCOTT



The 'Roll-on' Cargo Carrier



NO matter how big or fast commercial aircraft become, they will never rival the ship for sheer heavyweight ability to move thousands of tons of bulk cargo and trade goods around the world.

Big cargo ships are becoming more and more efficient as their designers steadily improve their cargo handling equipment. Just as an airliner is not making money while it is on the ground, so a ship is not earning its keep while it is tied up at a dockside loading or unloading. Consequently, speed in turn-around is essential.

Until the last few years, a cargo ship has been a huge box to be filled and emptied from above by heavy cranes, a slow and ponderous process, despite the skill and hard work of stevedores and dockers. Once the cargo was unloaded, there were still many more stackings, hoistings and loadings to do before the cargo was on its way to the customer.

One of the new ideas in cargo handling is the "Ro-Ro" technique, short for roll-on, roll-off. It means quite simply that the ship has one or more huge doors through which the cargo can be driven on and off, on wheels.

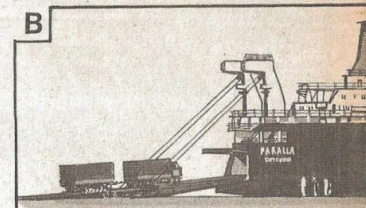
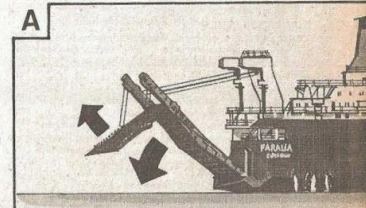
A new and most impressive "Ro-Ro" ship is the 20,225 deadweight tons "Paralla" freighter, built by the Eriksberg shipyards at Göteborg on the south-west coast of Sweden. Her roll-on-roll-off roadway is a mighty folding ramp which dominates her whole appearance, particularly from the stern, as can be seen in the main illustration on the left. This ramp, a massive 150 tons structure, is in two sections, hinged to fold double as it is raised to the closed position, so as to reduce the flat "sail" area it presents to the wind.

The ramp is angled at 40 degrees to the starboard side of the vessel so that it can be used alongside any straight quay and needs no specially-shaped shore installation. The ramp is designed to support most of its own

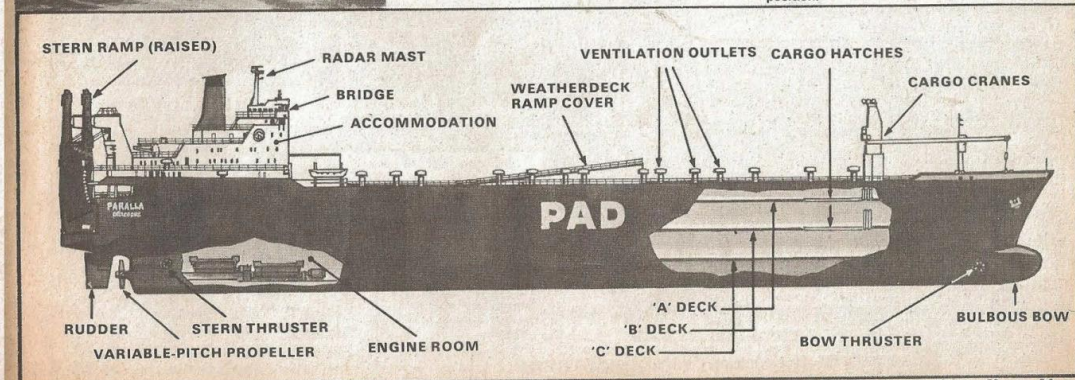
weight on its lifting cables, so that the bearing strength of the quay is no problem.

It can support a total vehicle load of 65 tons at a time. Cargo is loaded on to three decks below, and the weather (or top) deck. All levels are connected by internal ramps.

"Paralla" carries her own fleet of cargo-handling vehicles, including two 25 ton straddle carriers with magnetic lifting gear, two 13 ton carriers for timber work, several types of fork lift truck and even a sweeping machine to keep the decks clean! There is even a jeep to move cargo lashings about, and a motor cycle for the crew member who is on cargo inspection duty!



A. The stern ramp unfolds as it is lowered for vehicles to come aboard. B. Note the inner door, which hinges upwards. In the diagram below (and in the big illustration) the ramp is in the fully raised position.



LOOK LEARN

No. 515 27 NOVEMBER 1971

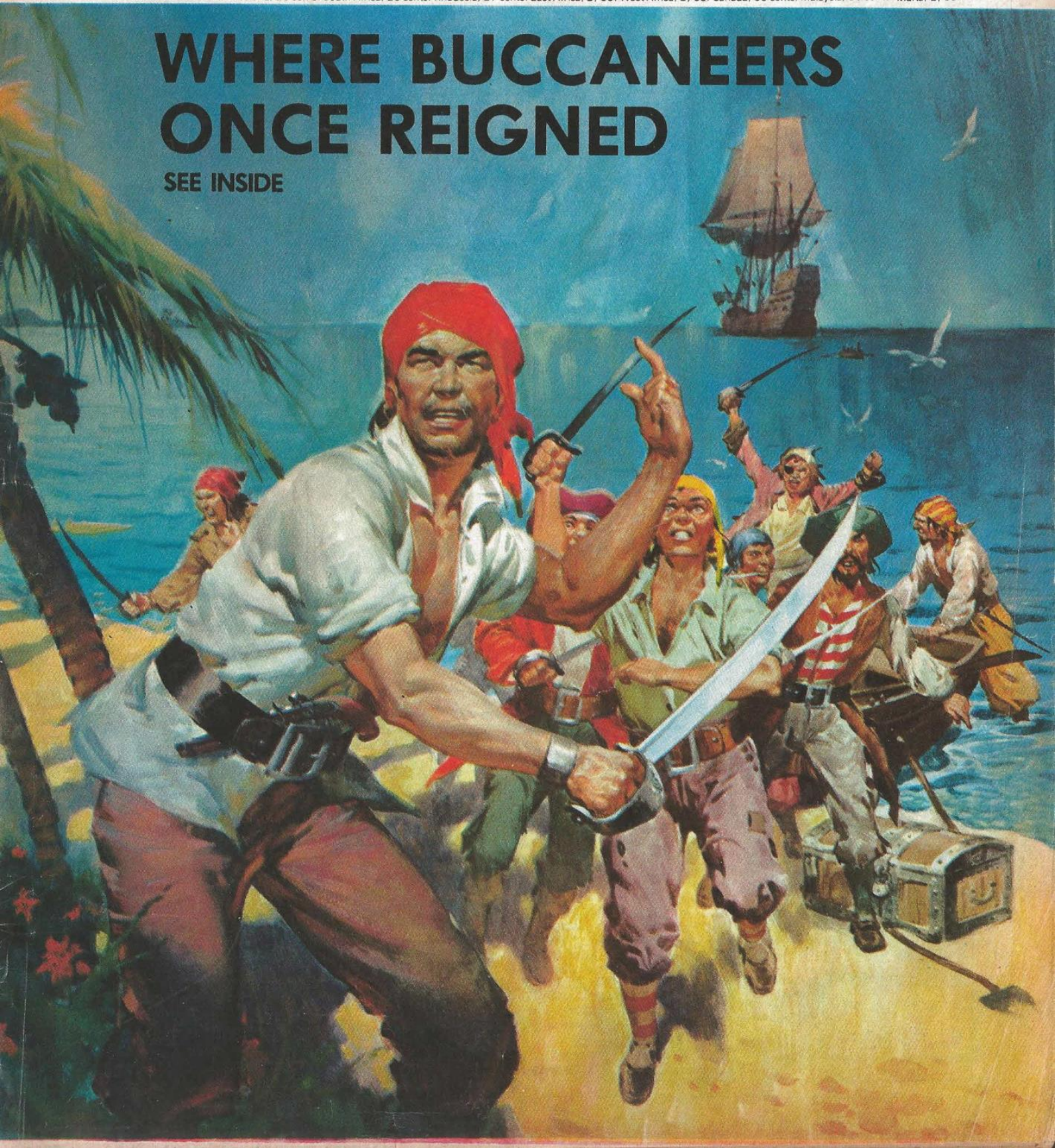
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WHERE BUCCANEERS ONCE REIGNED

SEE INSIDE



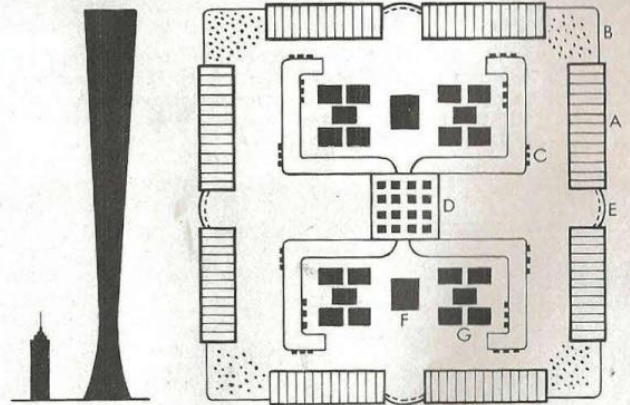
LOOKING INTO SCIENCE

SUPER CITIES IN THE SKY

As more and more people move into our big cities from the country, the cities keep growing and moving out into the country. As we reach the beginning of the 21st century, buildings will become higher and higher...

Below is a floor plan of what might come to be a feature of living in the centuries ahead . . . Compare the height of the Empire State Building at 1,472ft. (including the television aerial on top) and the 11,000ft. of the skyscraper of the future.

A flats B Observation window and indoor garden C lift door D Main lift shafts — 3 lifts to each main shaft E emergency express lifts for fire, ambulance services, police F cinemas G shops, chemists, restaurants, post offices



FOR many years the Empire State Building in New York has been one of the wonders of the world. It rises to a height of more than a quarter of a mile above the city. More than 10,000 people work in its shops and offices. If you work on the 80th floor you take an "express elevator" (lift), otherwise you might take more than half an hour to get there if the lift had to stop at every floor.

Even the stainless tower at the top is a small skyscraper, and was originally built to moor the giant dirigibles which once were the proud "liners" of the air.

Yet in the future the mighty Empire State will probably not even be thought of as a skyscraper at all. It will be dwarfed by the incredibly tall buildings which today's architects are busily planning on their drawing boards. In fact buildings at least **two miles** high are now believed to be quite practical by many architects and engineers.

Just imagine **living** in a two-mile high skyscraper and going to work in the morning.

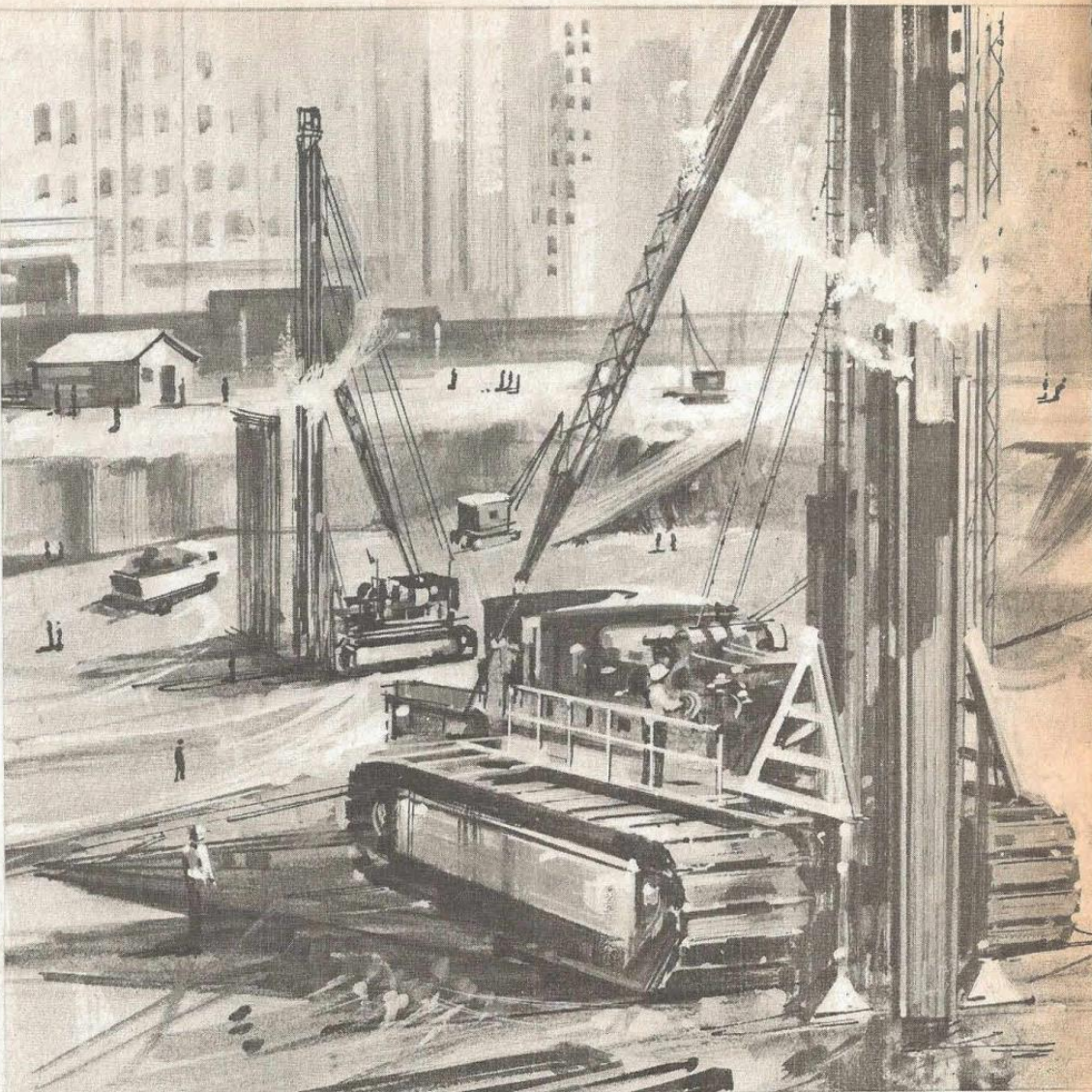
And to make things as interesting as possible imagine you are living **very** high up. On, perhaps, the 345th floor. There would of course be many more people living above you, for a building of this height would have just about 500 floors!

After having breakfast you would leave your flat and find yourself not in a hallway, but in a large area as big as the market square of a small town. Miles of "strip lighting" along the high ceiling would make everything as bright as day. In this "super-hallway" you could find shops, restaurants where you could eat a second breakfast if you felt like it, a post office, a chemist, and perhaps a small "news cinema" where you could watch a film for a while if you were an hour early for work.

CITY IN THE AIR

To get out of the building you would have to wait in front of a long row of lift doors. There might be as many as a hundred others waiting with you, for on this floor alone there would be about 160 flats, with an average family of three living in each one. And for the whole 500 floors that would mean that the super-skyscraper could hold the population of a large town — at least 240,000 people.

Living on the 345th floor you would have to take a lift twice — the first lift would be called a "local" and would take you down to the 300th floor. An "express" lift would then rush



Today pile-drivers are used to drive building foundations deep down into the ground. When building super-skyscrapers, however, the immense weight of the building would be used to push the building's foundations deep into the ground.

you down to the ground floor.

The lift system would be "three-dimensional" — the lift would take you along two sides of the shopping area before plunging straight downwards. Naturally, the flats most in demand would be those which had an express lift, so that the whole long journey could be made in one go!

It might be interesting to pay a visit to the very top floors of the building. There you would find the huge engines which ran the hundreds of lifts. You might also find mysterious locked rooms with a strange whirring noise coming from inside.

These would be the "gyro-scope" stations, where immense wheels made of tons of steel would be whirling around at great speed, driven by powerful electric motors. These gyroscopes have been designed to stop the high building swaying from side to side during high winds. Very small gyroscopes are used today on ships to keep compass needles

always pointing North.

Even a building as "short" as the Empire State sways a little during a gale — not very much, a few inches or so.

SKILLED WORKERS

In addition to the 500 floors above ground there would be at least 50 floors **below** ground. Here would be the flats for the people working in the building: technicians to keep the lifts, gyroscopes, and central heating and airconditioning units in good order. All the heating (and cooling) machinery would be controlled by complicated computers, which would have to be tended by skilled computer engineers and computer programmers. Special computers would work the whirling gyroscopes, and make them automatically run faster during gales and even hurricanes.

The skyscraper would use the most "space-age" materials: plastic strengthened with concrete, stainless steel, glass, and the strange new "super strong" metals like beryllium (which are lighter than aluminium yet tougher than steel), and the new "quiet" metals like manganese-copper, which are very strong yet have the same "sound-deadening" qualities as wool or soft wood.

Most of the building's sections would be made beforehand or "prefabricated" in special factories, before being transported to the building site and fitted into place as the skyscraper grew. And the very high floors which are now used on most sites would simply not be high enough for this job. The highest floors would have to be assembled using helicopters instead of cranes.

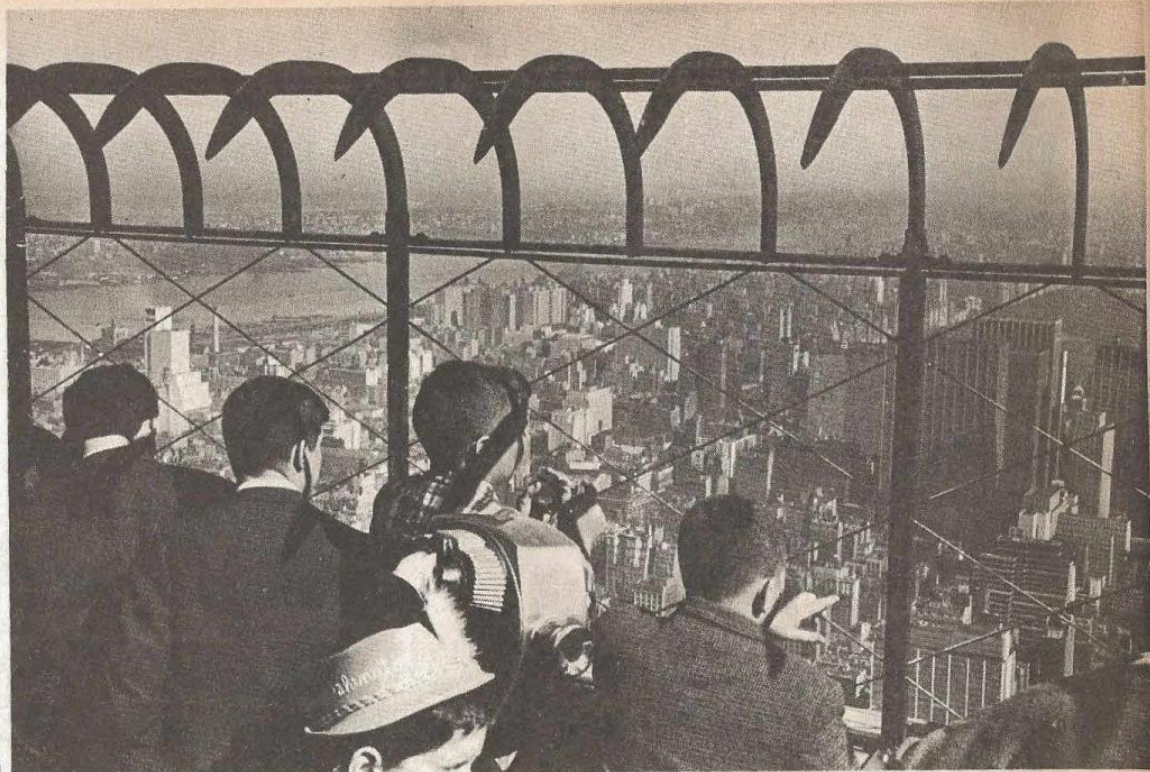
Certainly one of the greatest problems facing the building en-

CONTINUED ON NEXT PAGE

Building a two-mile skyscraper would be a feat of engineering involving as much skill, time, and work as building a complete city.

gineers would be deciding how the skyscraper could be properly supplied with water, gas, electricity, and telephone services. Even a town having a population much less than that of a two-mile skyscraper uses hundreds of miles of underground pipes, sewers, and cables. The super-skyscraper would use just as many miles, but all the pipes and cables would be concentrated into a much smaller area than even a small town.

Today the obvious solution lies in doing away with most of the piping, and providing the skyscraper with its own electric generating stations, telephone exchange, and rubbish disposal units. And each building like this in a city would certainly have its own underground and bus station !



The Empire State Building in New York, gives the sightseeing tourist a 50-mile view of the surrounding area — weather permitting ! Imagine what sort of view would be given by a building whose height was nearly five times that of the Empire State.



LOOK LEARN

No. 518, 18th DECEMBER, 1971

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ESCAPE IN THE SNOW

SEE INSIDE



HELICOPTERS-A PLAN FOR SAFETY



About 2,300 American military helicopters crashed in a recent two year period, about a quarter of them away from the battlefield, at a cost of over 1,200 lives. What can be done to make the helicopter safer?

THREE photographers died when a Royal Navy helicopter, from which they were taking pictures of an American destroyer, crashed into the sea off Portland Bill, Dorset. Four other men were picked safely out of the sea.

This happened in May this year, when one of the survivors explained, "The helicopter went straight down like a stone."

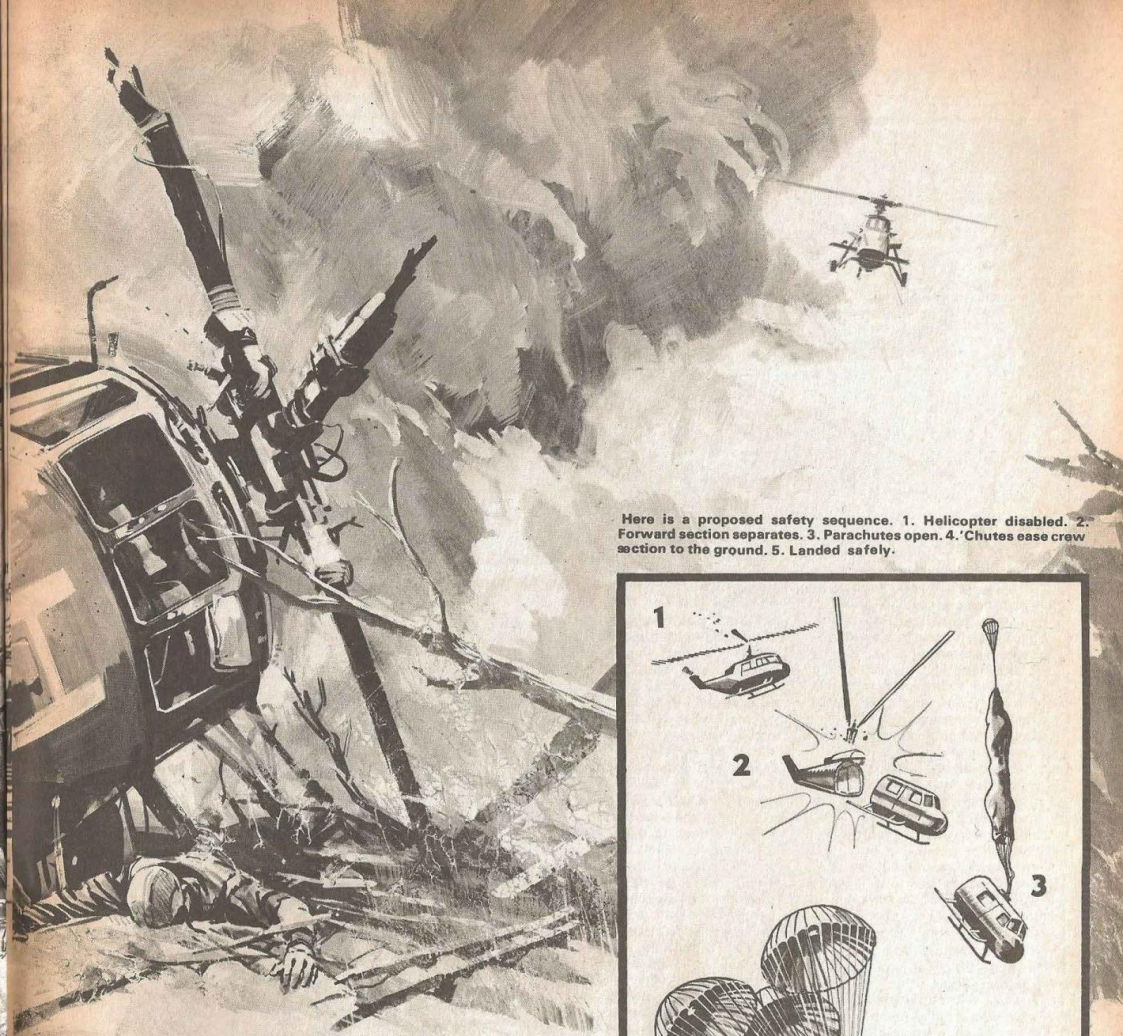
A few years ago, four men died as a rotor blade snapped off an R.A.F. Whirlwind helicopter, causing the machine to plummet into a field and blow up.

Early this year, Major Milton Roberts of the U.S. Army was

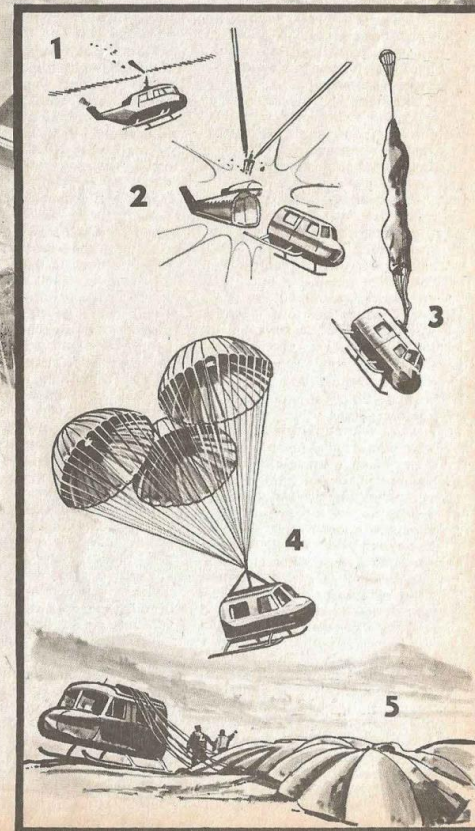
killed when his army helicopter crashed. Next day, astronaut Eugene Cernan, assistant commander of Apollo 14, narrowly escaped death when his "chopper" plunged into the Indian River near Cape Kennedy and burst into flames.

On the following day, a U.S. Coast Guard helicopter fell 1,000 feet into the frigid waters of Hampton Roads off Norfolk, Virginia, and nearly drowned two men.

These accidents occurred many miles apart, but they all had one thing in common. All the helicopters were piloted by highly experienced flyers who were



Here is a proposed safety sequence. 1. Helicopter disabled. 2. Forward section separates. 3. Parachutes open. 4. Chutes ease crew section to the ground. 5. Landed safely.



unable to escape from their falling aircraft. No safe way has been found for ejecting safely from a disabled "chopper."

"If you want to see how unsafe these machines can be, take a look at the records," an American officer said. We did, and these show that in two recent years, there were 1,989 American army helicopter crashes which killed 969 people. Of these accidents, 419 happened away from theatres of war.

In the same period, the American Marine Corps lost 227 helicopters, half the accidents occurring away from the battlefield. Of the 244 officers

and men who died, 109 were killed during training exercises, or while going from one base to another.

American Navy helicopter crashes for the two years came to 121, but the Navy refuses to say how many men were killed or to reveal how many accidents happened in or out of combat.

The tragic thing is that none of the flyers had a chance to escape death. A pilot's best chance to escape serious injury or death in a mid-air emergency is to put his helicopter into auto-rotation. This manoeuvre uses the upward flow of air to turn the rotor blades of a

CONTINUED ON NEXT PAGE

Unless safety devices are installed, only way to improve the helicopter's safety record will be to stop them flying—and that would not be feasible.



falling helicopter.

This will only work, however, if a pilot has control of his helicopter, is at a fairly high altitude, has favourable weather conditions and can see where he is going.

Unfortunately, the chances of executing a successful auto-rotation are poor, and there are a dozen or more things that can prevent it, such as a lost rotor blade or an electrical failure.

If a pilot is unable to auto-rotate, he must bail out or stay with his helicopter until it crashes. These craft usually fly at low altitudes, so there is practically no chance of making a successful parachute jump. Out of five pilots who tried to bail out recently, three died. For this reason, very few helicopter pilots wear parachutes in America. In contrast, the pilot of a supersonic jet has a 90 per cent possibility of ejecting safely.

The fact that it is the helicopter pilot who usually rescues the jet flyer makes this disparity in their chances of survival grimly ironic, when the American Navy realised

Because of this, the Naval Weapons Laboratory in America has been trying for more than ten years to find a reliable escape system for helicopter airmen. Their researches began in 1961 when the American Navy realised that the alarming fatality rate had to be reduced if it was to continue flying helicopters.

One plan after another was discarded until they had the idea of making the helicopter a part of the escape system by designing the fuselage so that it could be parachuted to earth.

By remaining inside the aircraft, the men have a better chance of surviving the parachute drop.

Senior officials shook their heads when the idea was first proposed and said that it would not work. But the engineers were convinced that the idea was a good one, and they proved it several years later when three remotely controlled helicopters were parachuted to safety.

This system is called HEPS, a slight rearrangement of the initials of Helicopter Personnel Escape and Survival. Because of lack of funds, it has not got farther than the drawing board.

One of the reasons for little progress may be that explosives are used to eject the fuselage which is parachuted to earth. These could be dangerous, although an explosives expert believes that with armour plating to guard the explosive from enemy fire, and the use of a type that does not explode on impact, they would be quite safe.

He bases this on the fact that charges have been used successfully in space capsules and are used to fire ejection seats free of disabled aircraft.

One method could be for a pilot in a helicopter to pull a ring. This would sever the rotor, leaving a free path for the pilot to fire himself into the air, where his parachute would open and the ejection seat fall away.

While there is little danger of a premature explosion, the falling debris from a helicopter might endanger other aircraft flying in close formation. For that reason, this solution is not practical.

HEPS, however, is the system which seems to offer the best solution because, as you can see from the pictures, the rotors are ejected, leaving the body of the helicopter to be carried safely to earth by its 'chutes.

This sequence shows how a CH-46 helicopter could be saved by the HEPS system described in this article. 1. Helicopter disabled. 2. Explosive charges sever the rotors. 3. 'Chutes open automatically. 4. Three 'chutes ease the descent. 5. Landed.

A HAPPY CHRISTMAS TO ALL OUR READERS

LOOK AND LEARN

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No. 519 25 DECEMBER 1971

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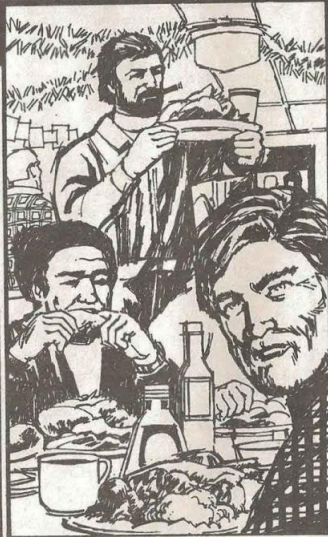
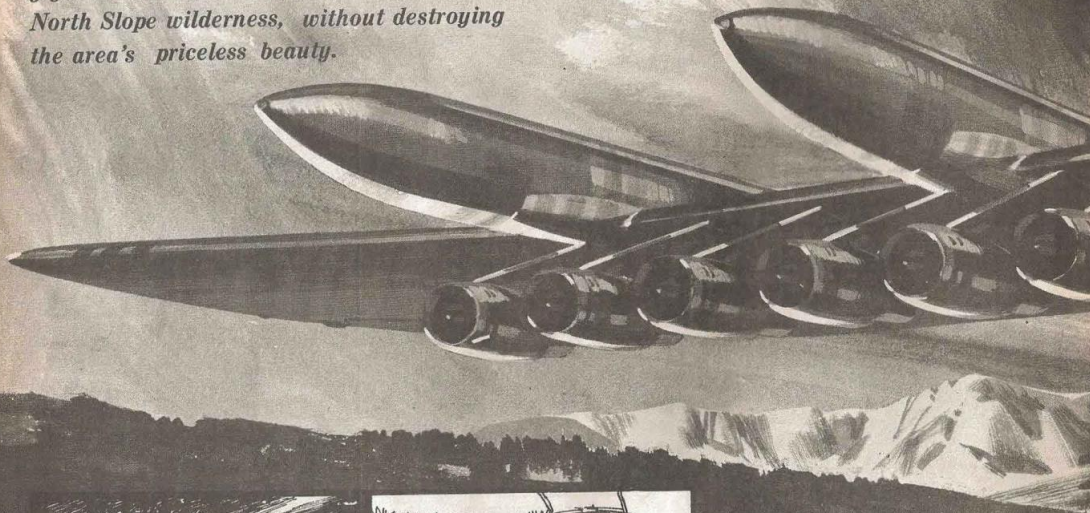
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WHATEVER HAPPENED TO SANTA CLAUS? SEE INSIDE

THE FLYING PIPELINE

A famous aircraft company has produced a gigantic idea for lifting the oil from Alaska's North Slope wilderness, without destroying the area's priceless beauty.



The working conditions on the North Slope are the worst in the world. The vicious cold is a constant and relentless enemy. A simple mechanical repair job which is child's play in easier climates becomes a mountainous task taking hours in a shrieking 60 miles an hour gale with the effective temperature down to minus 100 deg F. The men work clumsily and slowly, cocooned in layers of protective clothing with the ever-present danger of frostbite striking exposed skin in less than 30 seconds. To replace the energy and bodily heat they use up, the men consume vast quantities of food — the equivalent of your Christmas dinner several times a day.

AS YOU eat your Christmas dinner, spare a thought for the oilmen who are eating theirs in surroundings as warm, cheerful and as pleasant as yours, but with a 60-miles-an-hour gale howling outside the door.

In 1968, the first major oil find was made at Prudhoe Bay on the bleak lonely north slope of Alaska. A modern "Gold Rush" of oil companies followed.

Big freight planes flew hundreds of sorties bringing in the oil men and their thousands of tons of gear for locating the oil.

The oil has been found. The amount is staggering — the known reserves under northern Alaska are equal to one-third of the combined reserves of the rest of the United States.

The oilmen have worked hard to minimise their impact on the clean wilderness. No mechanical, or "tin can and cardboard" litter has been allowed, and drilling rigs are skilfully used to allow widely separated pipes to be sunk down to oil-bearing layers while the surface rigs stay in one small area.

Many wells have now been sunk and "capped" with the oil waiting to flow, so why is it not doing so?

It is remaining where it is because the answer has not been found to a very thorny problem. In hot or temperate lands, crude oil is already hot and free flowing from the friction and pressure of its rise from the depths when it gushes out of the ground in the pipeline. It is boosted along the pipe by pumping stations, and friction keeps it hot.

But in Alaska there is a problem. Beneath the thin green layer of tundra in the warm season, there lies a permanently frozen band of earth — called the "permafrost" layer — which literally holds the land together. If this layer is exposed to

heat, it melts and becomes a boggy, spongy mess in which pipes could not be laid.

The trans-Alaska pipeline would be a 48 in. diameter tube carrying oil at 180 deg F., and if this was buried in the "Permafrost" the result would be the melting of the frozen layer and, left without support, the sagging pipe might burst.

The alternative is to mount the pipeline on pikes above an insulating layer of gravel clear of the ground. But two fears are held for this method. Firstly, Alaska is a notorious earthquake area, and the pipeline could easily be fractured in an earth tremor. Secondly, the raised pipeline could interfere with the migration patterns of the herds of wild reindeer and caribou.

ICEBREAKER TANKERS

While the engineers and ecologists wrestle with these problems, others are seeking different systems for shifting the oil in bulk. The icebreaker tanker route through the north-west passage has been explored, and the designers of the famous Boeing Aircraft Company have come up with a flying tanker, pictured above.

It would be powered by twelve 50,000 lbs. thrust jet engines and would lift about 8,000 barrels of crude oil in four wing-mounted containers. The containers would be loaded and unloaded by giant cranes giving a time from landing to the next take-off of about six minutes. Boeing estimate that a fleet of 40 such aircraft, each making eight daily trips, could shift two million barrels of crude oil a day. A real flying pipeline!

Possibly, some of this could find its way to your central heating system. Perhaps on a future Christmas Day, the warmth you enjoy will have come from the frozen wastes of icy Alaska.

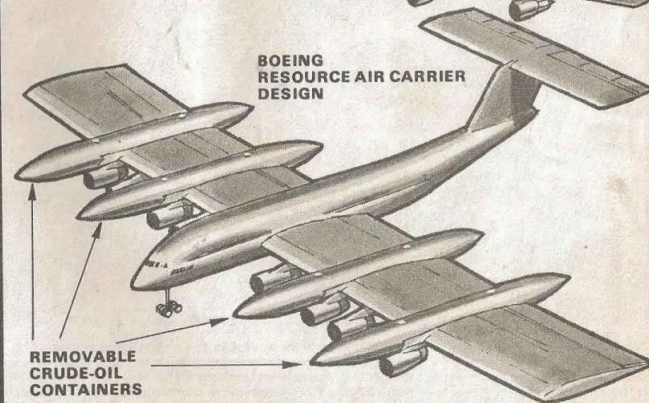


The famous Boeing 747 shrinks to insignificance beside its maker's "resource air carrier" design. The two aircraft are shown to the same scale. The wingspan of the giant oil carrier would be 440 feet and its length 259 feet.

BOEING 747 "JUMBO JET"



BOEING RESOURCE AIR CARRIER DESIGN



REMOVABLE CRUDE-OIL CONTAINERS

LOOK LEARN

No. 523, 22nd JANUARY, 1972

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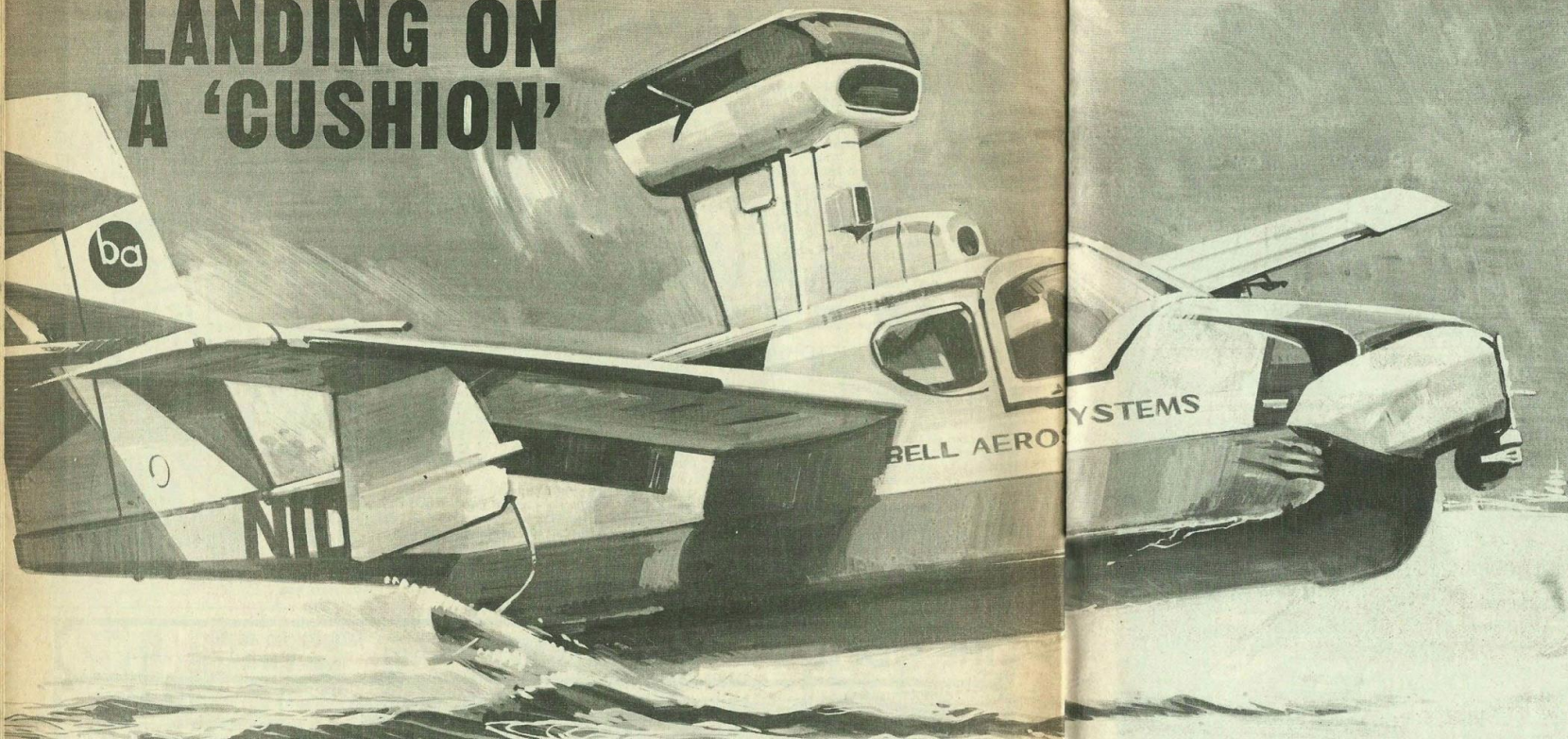
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LANDING ON A 'CUSHION'

SEE INSIDE



LANDING ON A 'CUSHION'



B RITAIN'S Christopher Cockerell began it all when he experimented with an air jet in a coffee tin and came up with the idea for a craft which floated along on a pocket of air.

This was back in 1954 and led to the famous Hovercraft which travels on any surface, land or water, and has given the world an entirely new form of transport.

The success of this has given the Americans the idea of using an air cushion instead of wheeled landing gear on ordinary aircraft.

With the Canadians, they are spending millions of dollars in the next four years to see if this system will work.

Already, it has been tested successfully on small aircraft. Now they are equipping a de Havilland C-8 Buffalo STOL (short take-off and landing) with the device to see if it will be suitable for planes with a gross weight of more than 40,000 pounds.

Called ACLS (air cushion landing system), it consists of a

Air cushions may replace landing wheels on America's planes of the future. This will enable aircraft to take off from rough runways or no runways at all—even from water. Useful in war for ferrying supplies to advanced troops and valuable in peace for reaching remote areas, they will add mobility to the air fleets.

rubber trunk connected to the underside of the fuselage and supplied with air from the plane's auxiliary power system.

Air escaping through hundreds of tiny holes in the trunk makes the layer of air on which the aircraft rides during take-off and landing.

The system is designed so that the aircraft can fly from rough ground, water, snow, soft soil or ice.

A big advantage is that the CLS spreads the weight of the aircraft over a large area, instead of concentrating it on the landing gear.

At first, the intention is to test the system for use on military aircraft, which may need to land or take-off without a proper airfield. But it will have great value for civil aircraft too, especially in the Canadian northlands, where some places are too remote for other aircraft to reach.

Overcrowded civil airports could be helped, too, if they are near a large stretch of water, such as a wide river or a lake.

In such places, there has been talk of building runways out in the water, perhaps on concrete piles. With a workable air cushion on a large aircraft, such construction would not be necessary.

Planes could just land on the water and taxi right on up to the nearest runway.

Colonel Charles A. Scolatti, who is in charge of a laboratory which is working on this system, says, "Pilots who have seen this and who have taken part in the tests, are really excited about what it can do."

On the test plane, the ordinary

landing gear was left intact in case the cushion failed. But its ruggedness was proved when an engineer punched holes in the inflated trunk with a knife, and the system continued to keep the aircraft clear of the ground.

He estimated that the trunk would continue to operate with as much as six square foot of holes in it.

Supposing a plane was damaged by gunfire, in war-time, for example, would the plane be safe?

"In a military operation," he said, "anything beyond the six square foot would be accompanied by structural damage to the aircraft as well, so the damage to the cushion becomes academic."

The trunk is made of natural rubber with nylon reinforcement. The rubber allows the trunk to deflate snugly against the fuselage and lie flat like a piece of carpet.

Another advantage of the system is that it reduces the stresses caused by cross-winds.

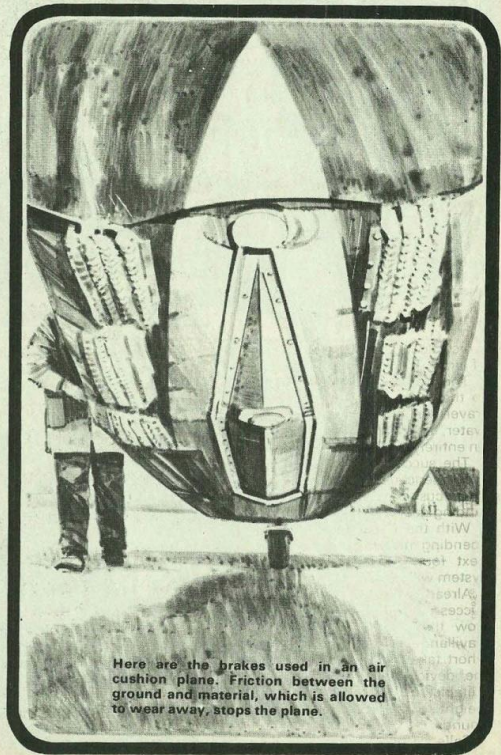
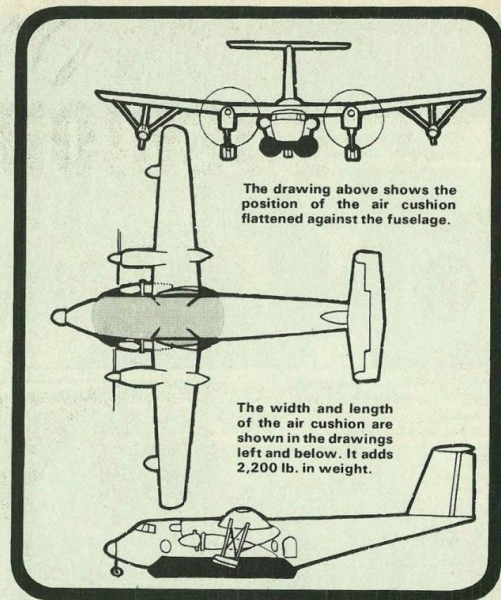
With the plane riding on a cushion of air, cross-winds will have no effect on a taxiing or landing aeroplane.

A braking system runs parallel to the fuselage on the bottom of the trunk. This consists of material which makes contact with the terrain or water on which the aeroplane is landing.

By varying the pressure within four bladders inside the trunk, the pilot can get either left or right brake or both. These bladders, when under pressure, seal the perforations of the trunk and serve as support for the aeroplane when it is not taxiing or landing.

These bladders can also be inflated or deflated to vary the height of the aircraft for loading or unloading cargo.

How long will it take for the air cushion system to become widely used. It seems that ten years is a good guess. By then, all the problems will have been ironed out to make it an important asset for military and civil planes.



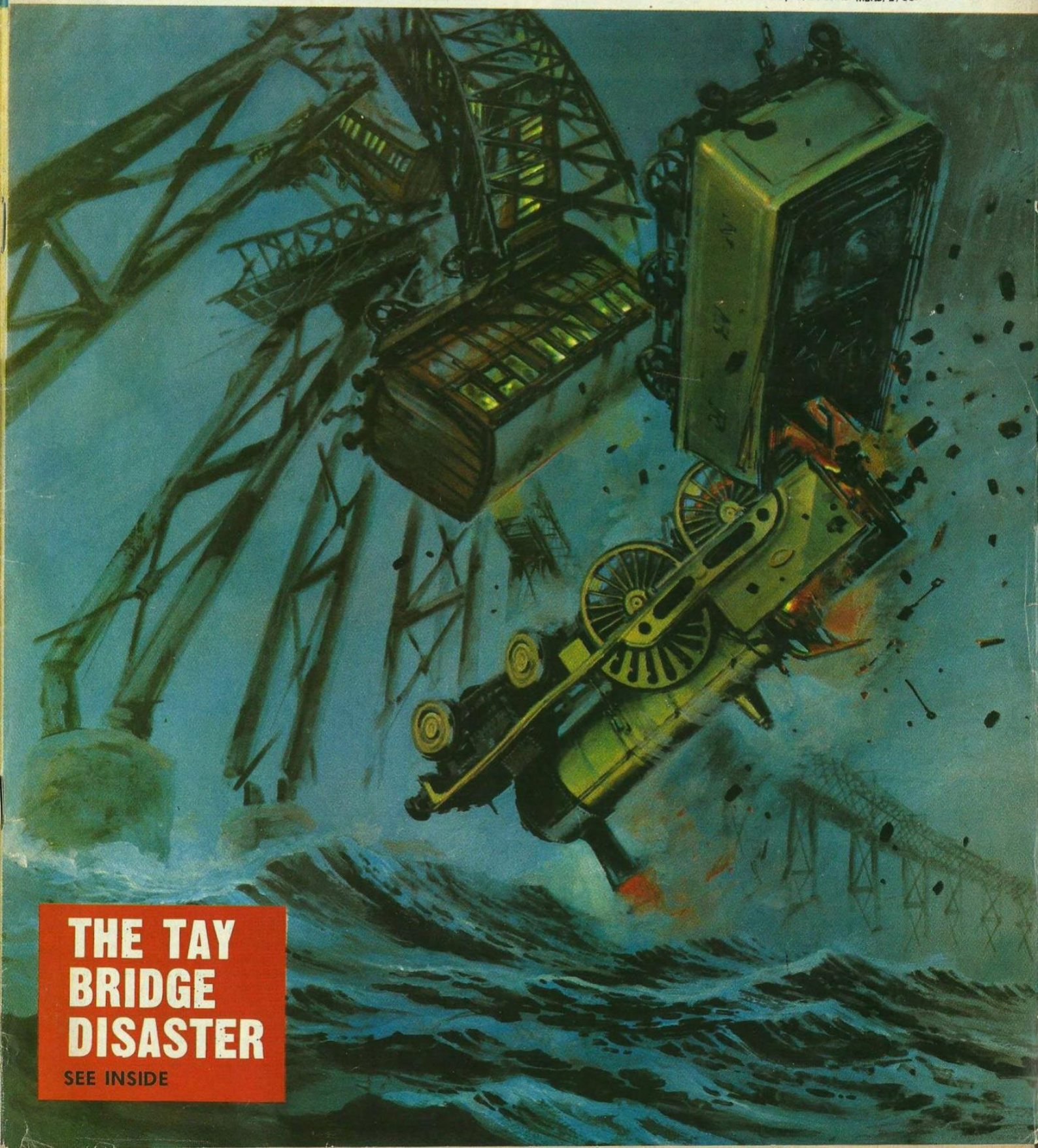
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No 524, 29th JANUARY, 1972

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THE TAY BRIDGE DISASTER

SEE INSIDE

THE SEA-GOING SEA-LOADER

You are looking at a picture of the world's largest dry-cargo ship—almost as long as three football pitches. Packed on three decks in 38 huge barges is 24,500 tons of cargo lifted on board by a 2,000 ton capacity elevator which is more powerful than any other crane in the world. If these statistics are staggering, something even more amazing is the fact that this mammoth ship can take on its enormous cargo without using a dock.

If you laid three football pitches end to end you would have some idea of the size of the giant cargo ship in this picture.

But it is no ordinary cargo ship. In the first place, it breaks all the rules by being loaded at sea instead of joining the queue of ships waiting for space at some overcrowded and busy dockside.

Secondly, its cargo comes aboard already packed in containers — in reality huge barges — which are floated out to it and then hoisted aboard two at a time by a huge lift.

"Containerisation" is the name for this form of cargo transportation. In Britain and Europe it usually means loading containers in factory sidings and taking them by rail or road to the docks, for loading on to ships and transport to their destination.

But the Americans have their eyes on places where the waters are too shallow for the big ships to come close to the docksides. Their answer is the enormous ship in our picture.

Containers from a factory, or barges loaded in shallow water, are taken by tugs to the ships moored in an estuary or elsewhere in deep water. The containers are floated on to a lift which is beneath the level of the water. This raises them two at a time to the level of one of the three decks on which they are to be stowed.

Once on the deck, the barges are pushed into position by transporters, which are like moving platforms.

THE CARGO KING

Now for some figures. In all, some 24,500 tons of cargo in 38 barges 97 ft. long can be loaded aboard the ship in just 13 hours, far away from docks and piers.

It would take more than a week to get this quantity of cargo aboard a conventional freighter at a dock.

In America, the first of these special cargo ships was launched on 10th July, 1971, and it really is amazing for it is the largest dry-cargo (as distinct from an oil tanker) ship afloat. Powering it is a 36,000 h.p. power plant to give it a speed of 20 knots.

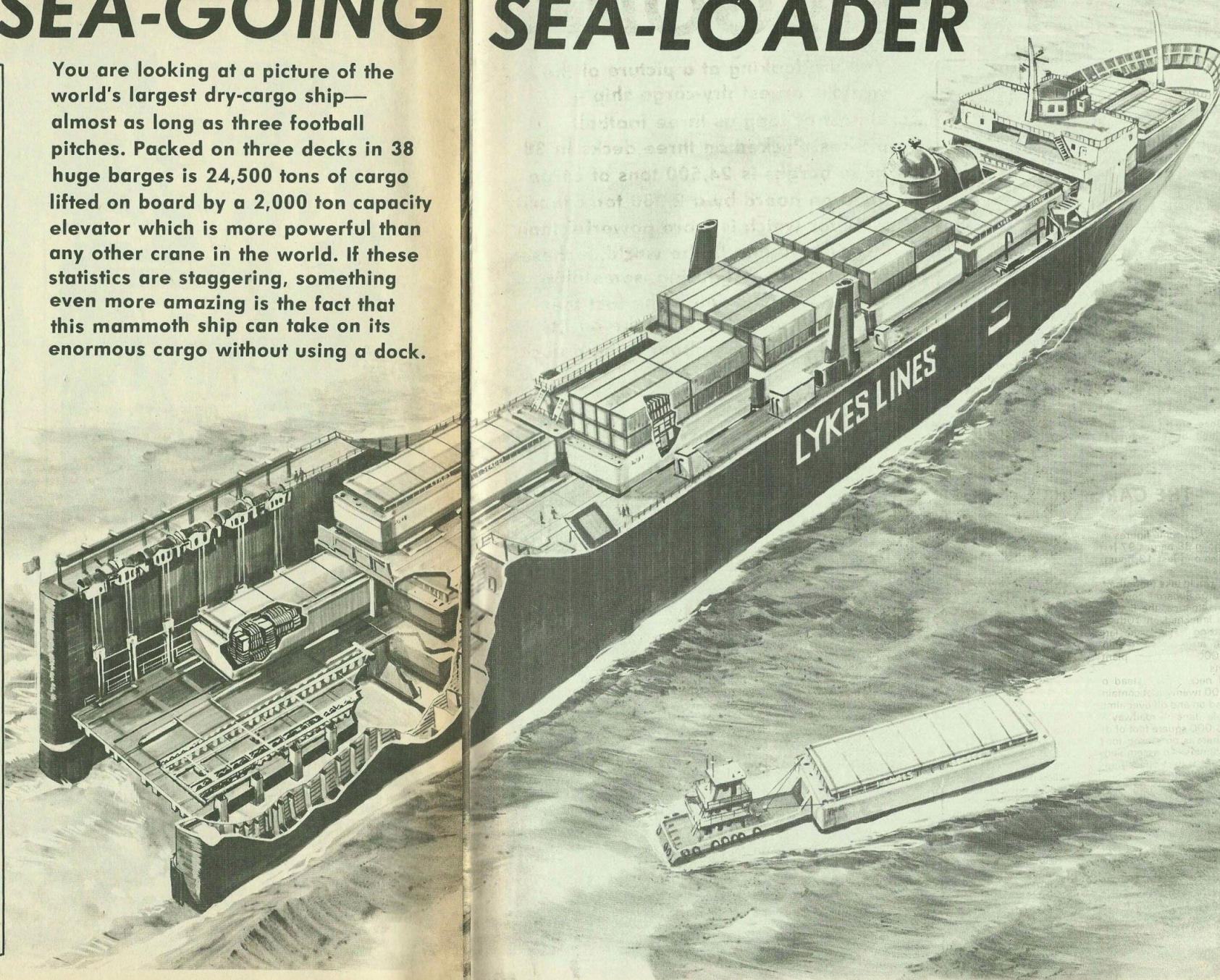
If necessary, instead of barges, it has room for 1,800 twenty-foot containers, or vehicles that can be rolled on and off over almost three and a half miles of single lane "roadway," covering an enormous 146,000 square foot of deck space.

There is no reason for the cargo to be limited to containers. An assembled oil rig could be stowed on the upper deck space free of overhead restrictions. A helicopter, including a huge one called the Skycrane, can be flown from the upper decks, giving the freighter great value for military operations.

Called the "Seabee" system, this method was invented by the Lykes Brothers Steamship Company whose idea was to improve their freight service to places without deep-water ports.

In doing so, they linked the shallow harbours and inland waterways with the world-wide sea transport system and speeded up the distribution of goods throughout the world by sea.

This is important because while the air leads for passenger travel, for freight the sea is king.



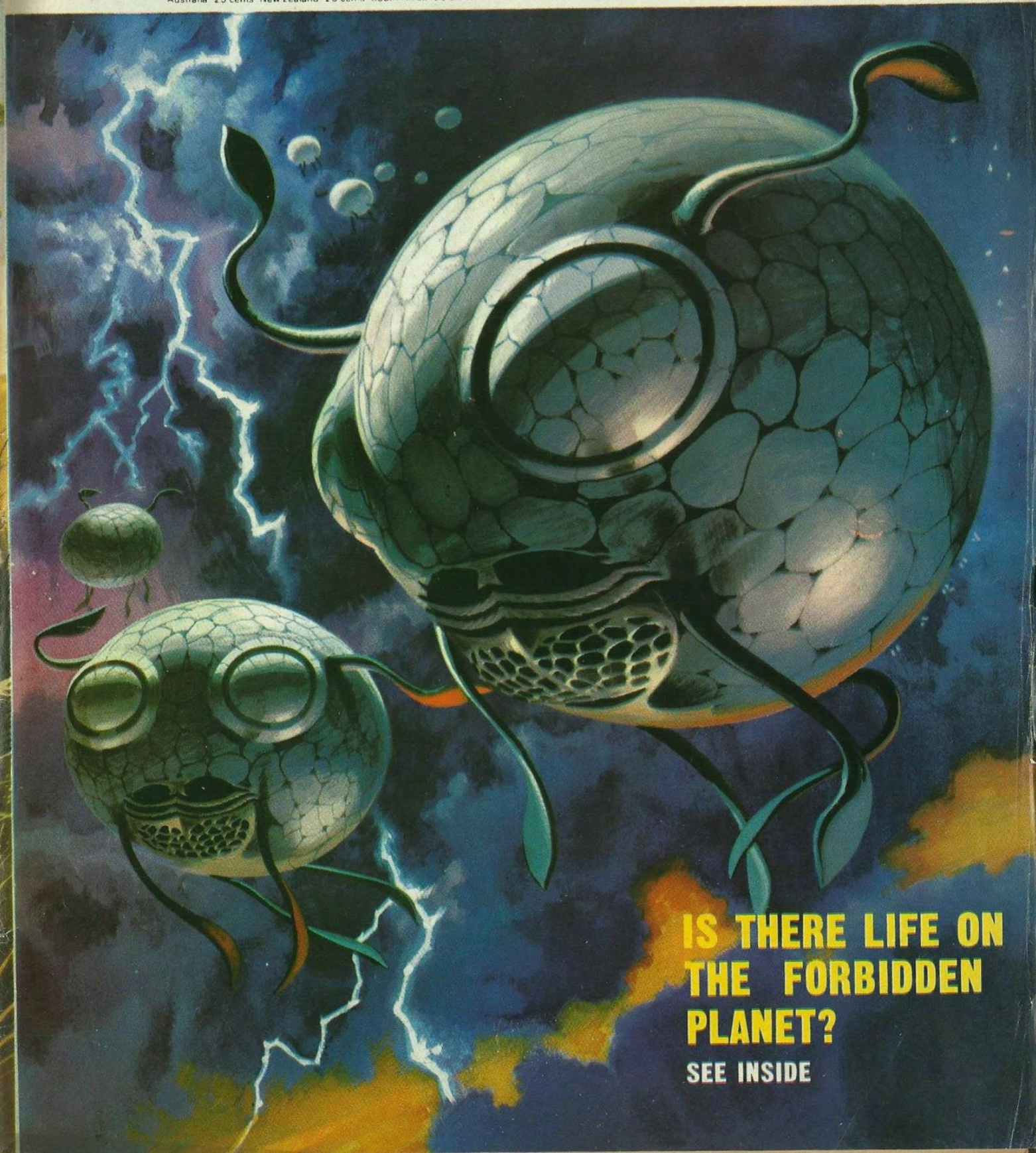
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No 527 19th FEBRUARY 1972

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**IS THERE LIFE ON
THE FORBIDDEN
PLANET?**

SEE INSIDE

LOOKING INTO SCIENCE

IS THERE LIFE ON THE FORBIDDEN PLANET?

We will never be able to visit this monster world whose atmospheric pressure could crush our space ship like an eggshell. But it is possible that alien forms of life could exist there . . .

THE most incredible thing about the planet Jupiter is its size — if it could be magically shrunk down to the size of a football our Earth would be about as small as a cherry. In fact Jupiter weighs more than all of the eight other planets put together.

And Jupiter is amazingly different from the Earth in other ways. It has no less than *twelve* moons. Its biggest moon, which is called Ganymede, is larger than our own Moon. The smallest moon is a lonely mass of rock which is not as wide across as London. It does not even have a name — it is simply called 'Number Twelve' and orbits Jupiter at a distance of more than 13,000,000 miles. Our Moon is a mere 240,000 miles away.

Our month (one Moon orbit of the Earth) is about 27 days by 'lunar' time. But Jupiter can have twelve different months to choose from, varying from six hours to over two years!

A 'year' on Jupiter is a very long time by our standards. A child on Earth could be born and grow up to be ten before Jupiter circled the Sun. And yet a 'day' on Jupiter is just over nine hours by our time — a

Jupiter calendar would have to be divided up into more than 10,000 'days.'

Because Jupiter is so far away from the Sun (more than 480 million miles compared with the Earth's 93 million miles) sun-light is very weak, less than a thirtieth of the brightness of our sunlight. This makes Jupiter extremely cold, in fact the upper layer of its atmosphere is probably a blanket of a kind of slushy snow of frozen hydrogen and helium gas.

LIFE CHEMICALS

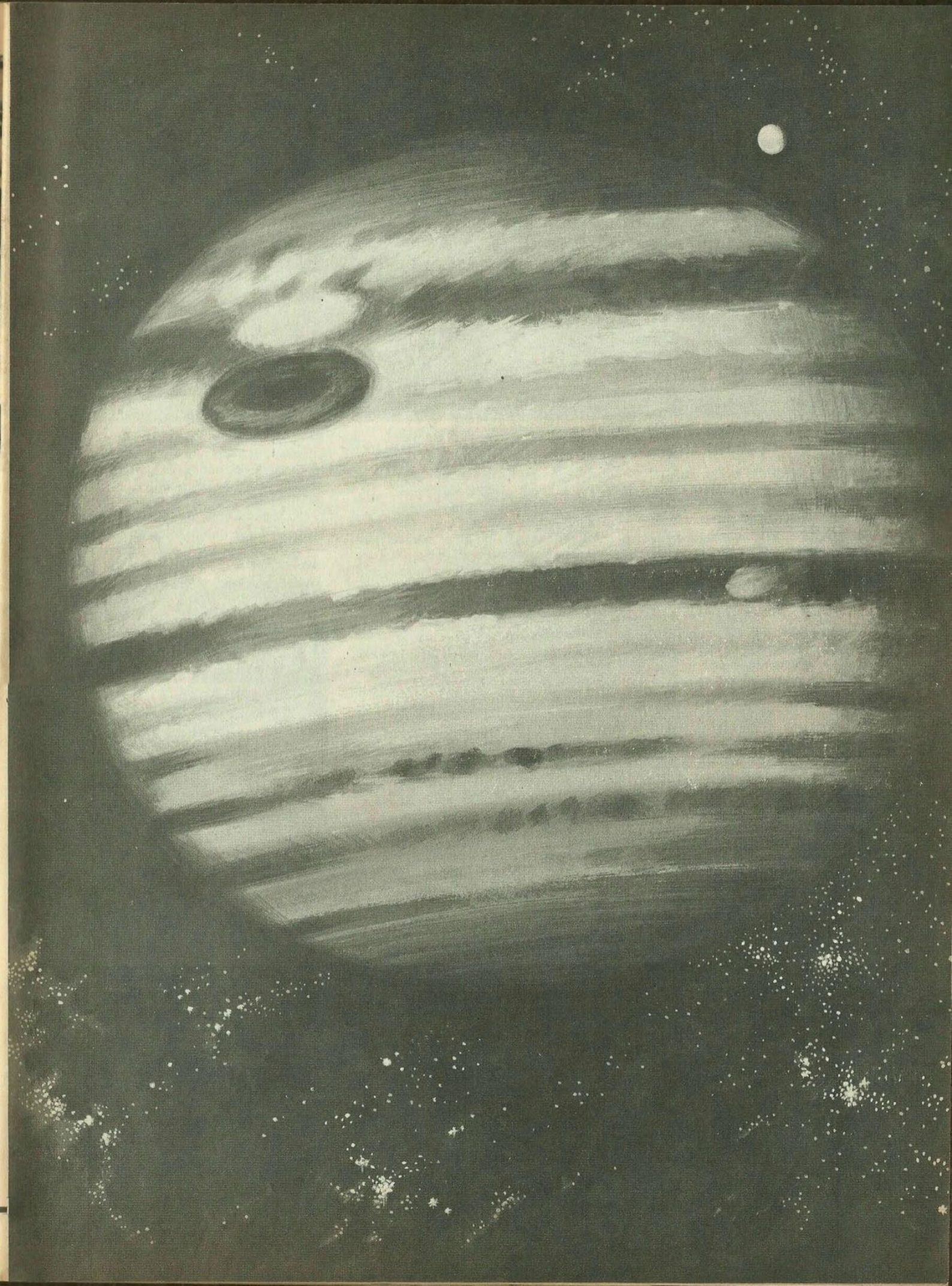
Although the "eyes" of our earthbound astronomical telescopes cannot see beyond this blanket of hydrogen snow, fantastic things may be happening beneath it. Today's scientists have developed special instruments which are attached to their telescopes to measure the temperature of Jupiter, and even analyse the chemical composition of its atmosphere, and make some surprisingly accurate guesses about Jupiter's "climate."

A steel cylinder stands on a laboratory bench. The polished sides of the cylinder

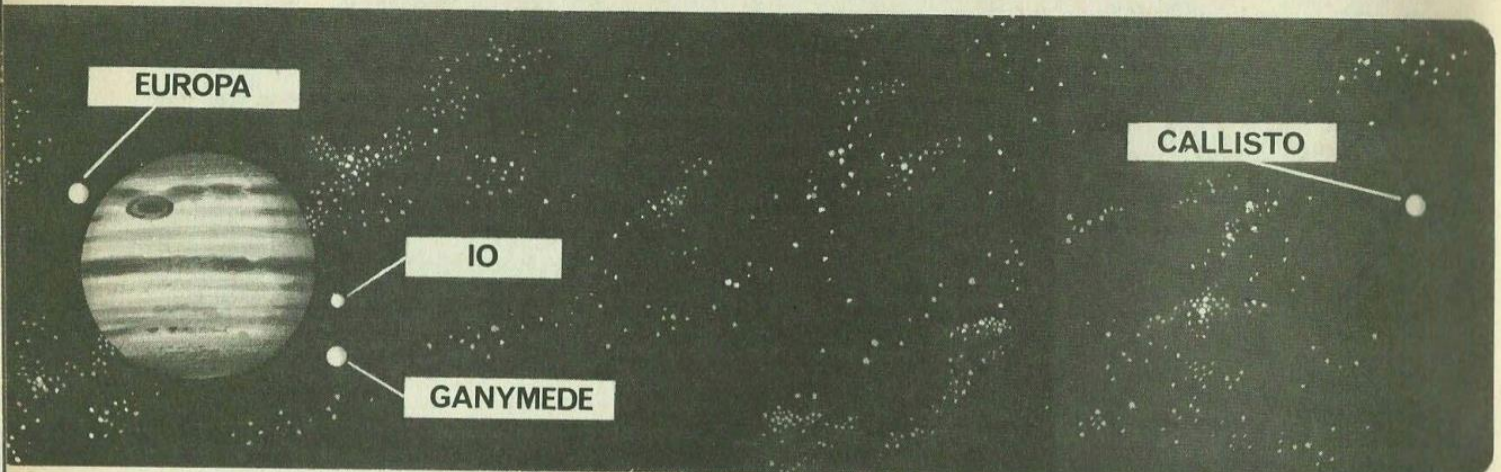
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The planet Jupiter, seen through an astronomical telescope. Notice the mysterious 'Eye' or Red Spot which keeps changing its shape. Some astronomers think the Red Spot is caused by the presence of primitive life forms, but others think it is more likely it is an effect of sunlight reflected by some huge storm constantly raging beneath the clouded atmosphere. Notice the size of the planet and the Red Spot compared with the Earth shown to scale here. Today scientists are busily studying the strange radio signals which come from Jupiter.



Some of the life forms on other planets may even be as intelligent as human-beings



are coated with frost and white wisps of vapour drift up towards the ceiling. Inside the cylinder a mixture of ammonia and methane gas is cooled down to a temperature of *minus* 180 Centigrade by liquid nitrogen (methane is one of the so-called *natural* gases which burns).

For several hours a powerful electric spark courses through the gas mixture, and then the cylinder is opened. Inside is found a small quantity of complicated chemical compounds called *amino acids*, formed by the effects of the electric spark on the ammonia-methane mixture.

What is happening is extremely important for scientists, for amino acids are now being called the "life chemicals." Different types of amino acids, combined together in many different ways, can produce the complicated molecules which are the basic building blocks of living cells!

Scientists call this strange apparatus a Jupiter Simulator. The gas mixture inside the cylinder imitates or *simulates* almost exactly the kind of atmosphere which is believed to exist in the hidden regions below Jupiter's blanket of hydrogen snow.

Here violent lightning storms are raging all the time. These storms extend over thousands of miles amid torrential "rains" of liquid ammonia and "blizzards" of ammonia snow.

And the giant lightning flashes, which would make our lighting on Earth look like flickering candle flames, are believed to be making a continuous supply of the life chemicals or amino acids in the Jupiter atmosphere. Perhaps some strange form of life does exist there now, in the form of microscopic plants or bacteria.

Even if there are no "higher" forms of life at present, it is fascinating to make reasonable scientific "guesses" about future "animals" which might inhabit Jupiter.

These creatures, living in near darkness

due to the very weak sunlight, might find their way about using some form of radar, just as bats here on Earth use very high-pitched sounds.

And just as eels and other animals here on Earth can produce electricity, it is quite possible that these Jupiter creatures could produce radio waves, which could be used for a most effective kind of radar indeed.

There are a number of stars which astronomers like to study with their telescopes, for very exciting reasons. One of these is called Barnard's Star, which is now believed to have at least one planet as big as our Jupiter.

This planet cannot be seen, even with our largest telescopes, because its star (or "Sun") is much too far away, its light taking more than six years to reach our telescopes, travelling at a speed of 186,000 miles a second.

MONSTER

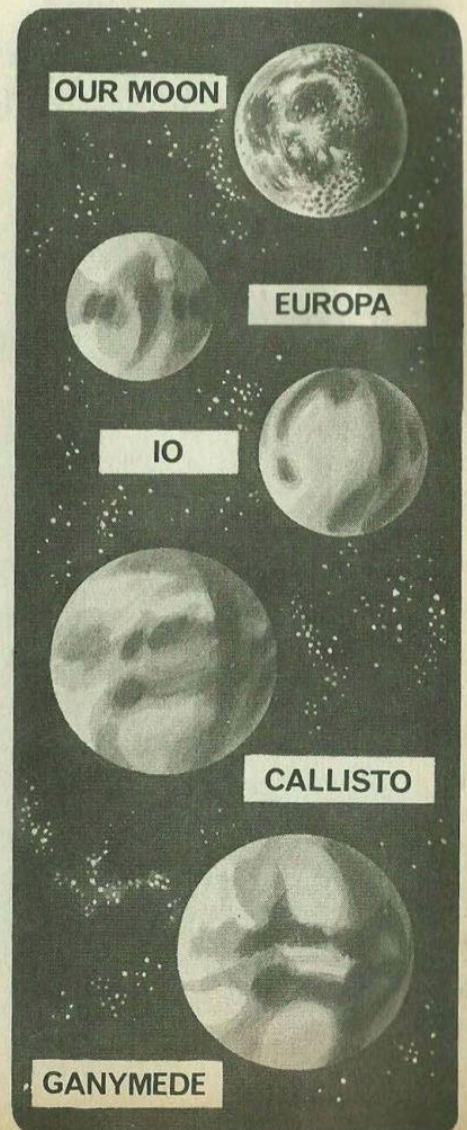
But the big planet is known to be there, because its immense gravitational force seems to make Barnard's Star move about in an abnormal way. It wavers from side to side instead of moving through space in a straight line.

Other stars also have Jupiter-like planets — one of these, the star "CN 2347" is believed to have a planet which is *twenty times* as big as Jupiter.

And this monster is also believed to be very much older than Jupiter. Old enough in some ways for relatively high forms of life to have evolved there. Some of these life-forms may even be as intelligent as human beings!

Unfortunately CN 2347 is so far away that a visit by space probe or manned space ship remains impossible for present-day astronauts. Even if they could travel near the speed of light it could take more than 100,000 years to make the return journey...

Here, drawn to scale, are the four largest moons of Jupiter. Ganymede is as big as the planet Mercury. These four Moons were discovered by the Italian astronomer and scientist Galileo in 1610. Although the relative sizes are to scale, they are not all so near the planet — they are either nearer or farther away from us.



LOOK LEARN

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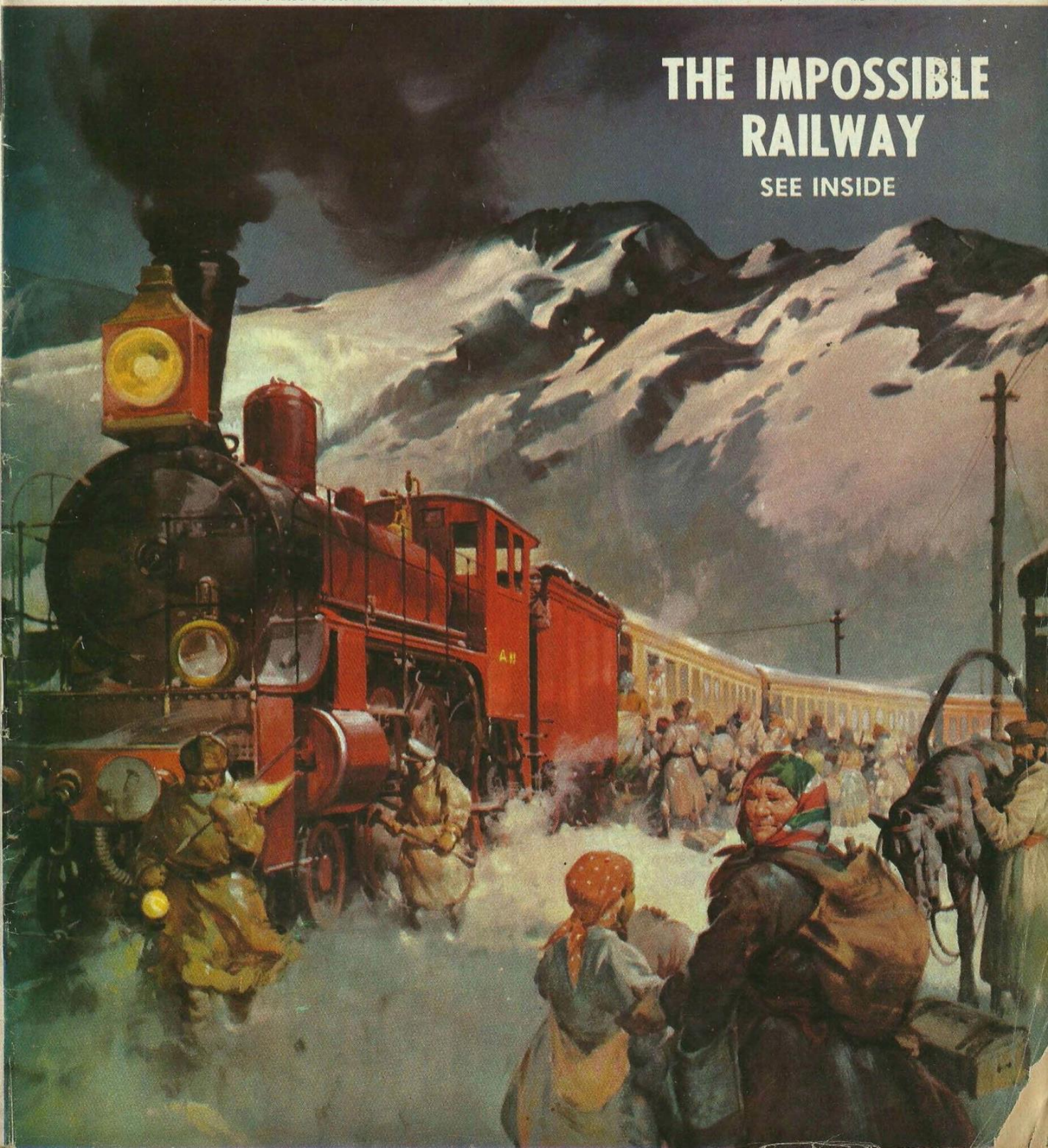
No 529, 4th MARCH 1972

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THE IMPOSSIBLE RAILWAY

SEE INSIDE



LOOKING INTO SCIENCE

BREAKING THE TIME BARRIER

How will Man explore even the nearest of the stars? Perhaps our descendants will send off a giant space ship on a century long journey, and on board there will be families who hope that their grandchildren will reach their destination.

SIXTY SECONDS were left of the countdown before blast-off and on the launch-pad wisps of vapour drifted lazily up into the air from the frosted metal skin of the giant booster. High up in the rocket's nose the last six astronauts were ready to make the last shuttle up to the mother ship which was waiting in a high orbit around the Earth, somewhere in the distant future.

Blast-off, and in a few minutes the shuttle had roared out of sight, leaving behind a long trail of white smoke — a sombre memory of a team of astronauts who would never be seen on Earth again.

The mother ship in orbit had been christened Century Parsec — Century because the journey was to last 100 years, and Parsec (93,000,000 miles, the distance of the Sun from the Earth) had been chosen because it was the astronomers' unit for measuring vast distances.

The destination of Century Parsec was Barnard's Star — about 400,000 parsecs or 36 million million miles away. It was one of the closest stars to the Earth and had been named after a famous astronomer of the 20th century.

Waiting in the mother ship were 50 other astronauts and their wives who were all scientists. Then there were their sons and their wives, all in their early twenties. And blissfully unaware of what was happening were the astronauts' grandchildren — busy in Century Parsec's special playrooms.

For when the giant ship did reach at last the solar system of Barnard's star, it would probably be the grandchildren or even the great-grandchildren of these living grandchildren who might be the first to land on

one of those mysterious planets which had been discovered orbiting Barnard's Star

STRANGE DESTINY

At the time it seemed to be the only way for Man to explore even a small section of the vastness of the universe. Brave scientists had volunteered to spend their lives in space.

Yet a visit to one of the nearest stars was hardly very astounding by astronomers' standards, even though it would take 100

years and involve at least five generations of human beings. For the astronomers knew that it could take more than a million years to explore even our own galaxy. And to actually visit the galaxies they had discovered far beyond our own would take thousands of millions of years, travelling almost at the speed of light (186,000 miles a second).

CITY IN SPACE

Building the Century Parsec had taken almost six years. The various parts had been made in Earth-based factories, then they were lifted into orbit by successive trips by shuttle rocket. The ship was then carefully assembled in orbit by engineers who flew about like strange birds in a state of weightlessness, propelled by their individual rockets.

The astronauts were to live and work and raise their families throughout the journey in three immense wheel-shaped cabins. These were set spinning by a series of small rockets and would keep spinning during the trip. Centrifugal force created by the spin would furnish the astronauts with artificial gravity so that their health would not suffer from continued weightlessness.

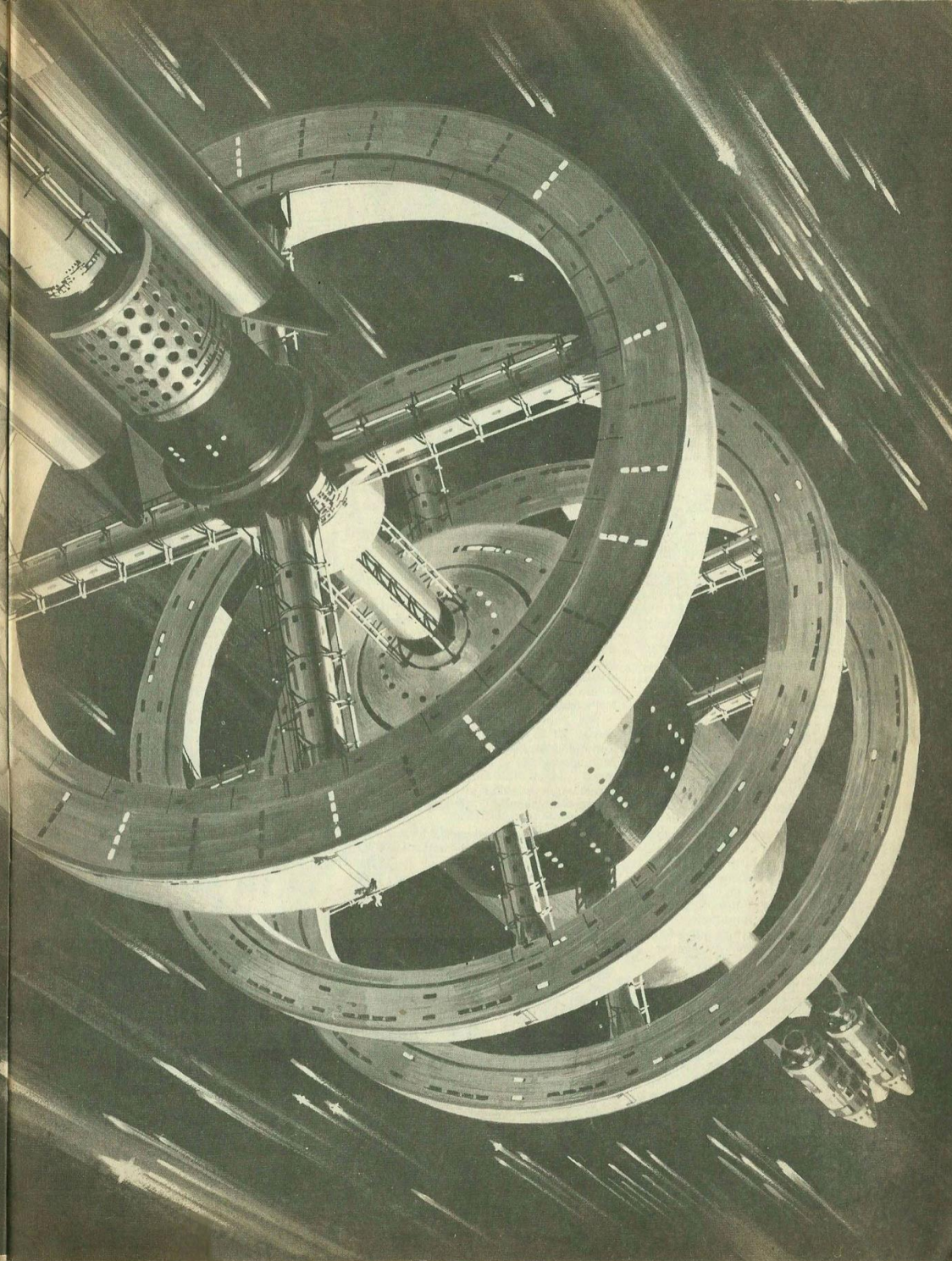
Spaced around the forward cabin like the spokes of a wheel would be control centres, radio, TV, and radar stations and the main space-navigation centre. There would also be repair shops, cinemas, a fully equipped hospital, and a library of more than 200,000 books recorded on microfilm.

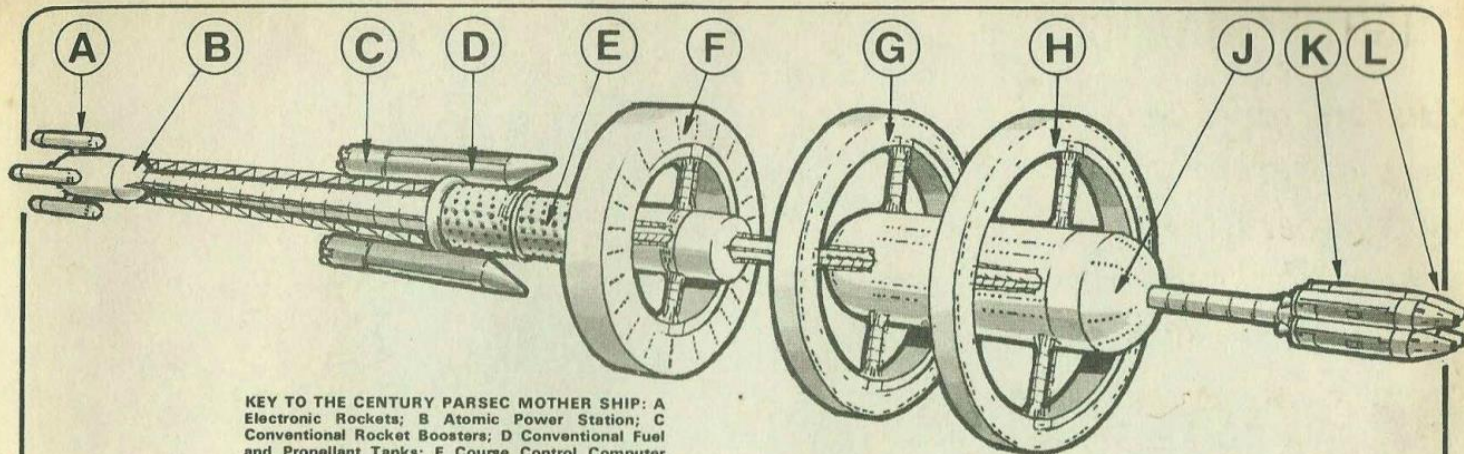
In the central cabin amidships would be classrooms, school and college laboratories.

CONTINUED ON NEXT PAGE



A playroom in outer space! On the long trip to one of the nearest stars, a trip destined to last 100 years, the children will have playing facilities, as well as classrooms and well-equipped gyms.





KEY TO THE CENTURY PARSEC MOTHER SHIP: A Electronic Rockets; B Atomic Power Station; C Conventional Rocket Boosters; D Conventional Fuel and Propellant Tanks; E Course Control Computer Centre; F Living Quarters; G School and Training Centres; H Control Stations, Radio, Radar, TV, Navigation, Hospital, Cinema, and Microfilm Library and Records; J Air, Food and Water Plant Equipment, Storage and Machine Shops; K Planet-Orbit Command Modules; L Planet-Landing Modules.

ories and a space-training centre for the future astronauts.

There would be a very space-age "do-it-yourself" workshop where clothes, furniture and toys could be made. And both grown-ups and children would keep fit in several gymnasiums!

The rear cabin would be the largest and contain about 250 modern flats for the astronauts and their families to live in, arranged in several concentric levels connected with both stairways and lifts.

Electricity for working radio and TV, heating and preparing food, and running various pieces of mechanical and electronic equipment would be provided in a number of ways.

SUN POWER

A continuous power source would be provided by nuclear reactors (atomic power stations) placed well to the stern, so that the entire crew would be safe from stray radiation.

Some years after leaving Earth electricity would be generated from the Sun's rays by a battery of solar cells. These would also be used when nearing Barnard's Star.

A huge cabin in the centre of the ship would house the most important equipment of all, the factories which *make* food to eat, water to drink, and air to breathe.

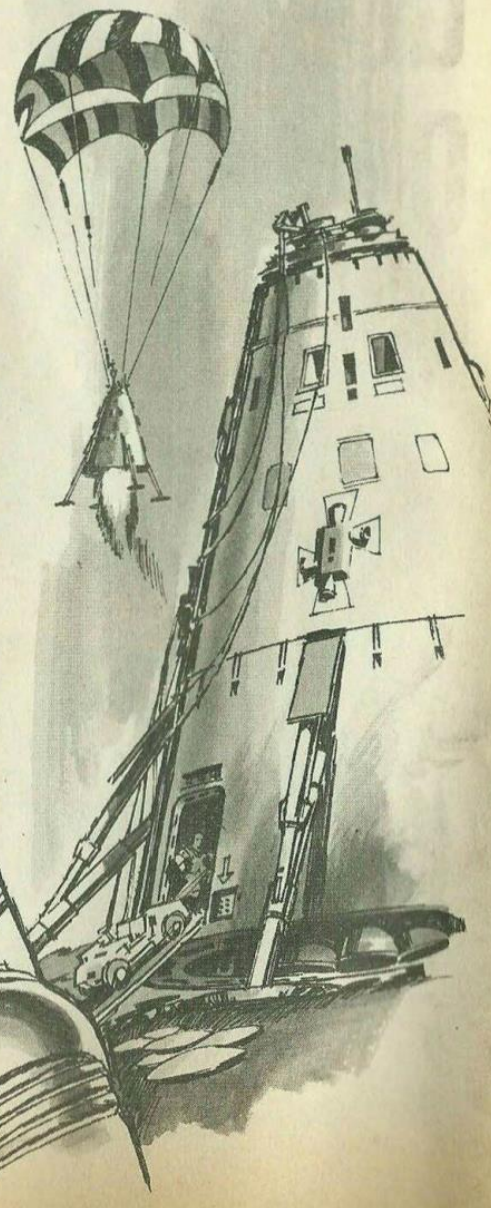
The long space voyage is over. The astronauts and their families have finally reached Barnard's Star. The ones you can see in this picture were not even born when the great journey began, and almost all of the original pioneers are dead. Now is the time to explore this new, strange world they have reached.

Food would be grown in yeast in vats: proteins, fats, and carbohydrates. Plant "cultures" would absorb the carbon dioxide breathed out by astronauts, and in turn would give off a constant supply of oxygen. Special laboratory apparatus would condense water vapour in the cabins, purify and filter it so that it could be used over and over again.

Conventional rockets would be used for leaving the Earth's orbit and perhaps entering the orbit of some planet in the Barnard solar system. The main trip would be made using electronic rockets — streams of electrons pouring out into airless space through rockets with atomically heated "throats".

The "nose" of the mother ship would consist of a battery of four combined Command Modules and Planet Landing Modules, similar to the ships now used to make a lunar orbit and a lunar landing. These would enable a possible landing or "orbital inspection" of a far distant planet.

A future voyage of a space ship like this, carrying several generations of astronauts would leave the Earth for ever. It would certainly be one of the most dangerous journeys into space that Man might ever make. But it might well be the only alternative to being trapped for ever in our own small solar system by the "time barrier".



LOOK LEARN

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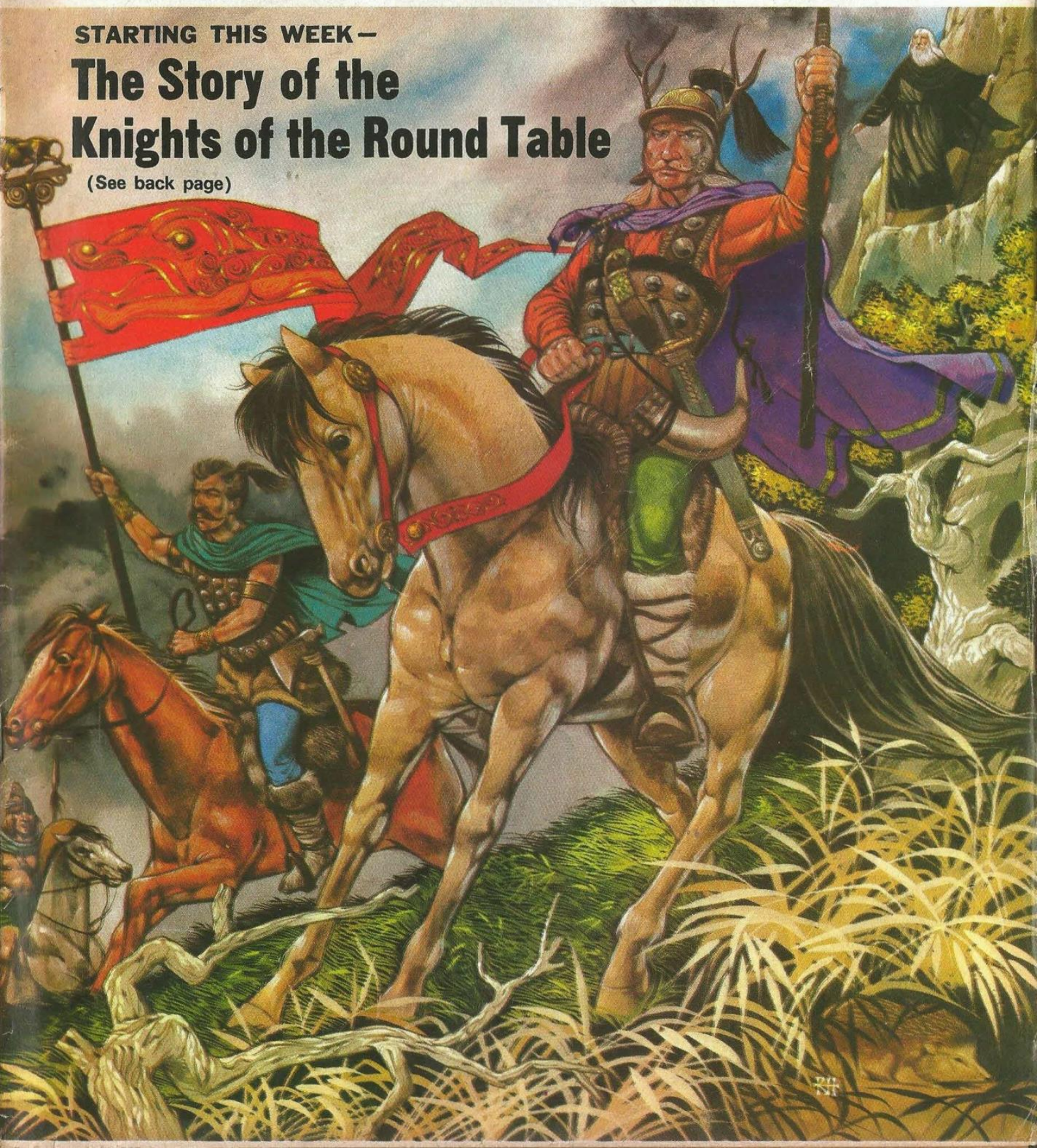
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STARTING THIS WEEK —

The Story of the Knights of the Round Table

(See back page)



LOOKING INTO SCIENCE

WORLD OF THE 'SUPER-THIN'

All the time in every big city we are surrounded by super-thin films hidden away in the engines of motor vehicles. Films as thin as this can sustain life under water, make the picture on a TV screen and perform many other marvels in the world of science.

A ROOF of thin plastic a million times thinner than a sheet of paper keeps the people alive in the strange under-sea house on the right.

They are scientists who live for months on end in the ocean depths, studying the strange forms of life which exist there. They do not need to breathe oxygen compressed in tall steel cylinders which divers and frogmen normally do. They can breathe the oxygen which is dissolved in the sea water which surrounds them. Just as fish do.

In fact the thin plastic roof is an artificial "gill."

Scientists have discovered that very thin sheets of plastic can allow gases like oxygen to pass through them, but do not allow water to pass.

The gill of a fish works in just the same way, and consists of a thin membrane which allows oxygen to pass through into the bloodstream of the fish. The membrane, of course, is made from living cells, and not plastic!

"Super-thin" plastic is a very odd sort of material. To start with it is just about as thin as the actual molecules of which it is made. And between the molecules are empty spaces or holes. These holes are large enough to allow oxygen molecules to pass through, but are too small to allow the much larger water molecules to pass.

ELECTRONIC LIGHT

There are certain technical difficulties in designing an under-sea house with a "gill." Because of the pressure of the surrounding water, the thin plastic has to be specially reinforced with sheets of strong aluminium with hundreds of very small holes drilled in them to allow the sea water to come into contact with the plastic.

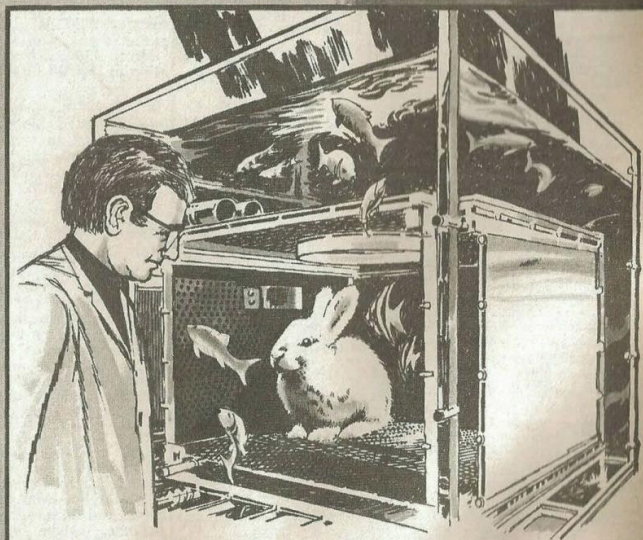
Super-thin membranes or films of plastic, metal, and other materials are being used for all sorts of purposes in this modern world, and engineers and scientists are busily thinking up new uses. The viewing-screen of a TV set is a super-thin film of a special chemical reinforced by thick glass. This chemical has the odd property of being able to change electricity into light.

Behind the screen, inside the viewing tube, a beam of *electrons* (ultra-tiny particles of electricity) sweep back and forth and up and down, scanning the back surface of the chemical film.

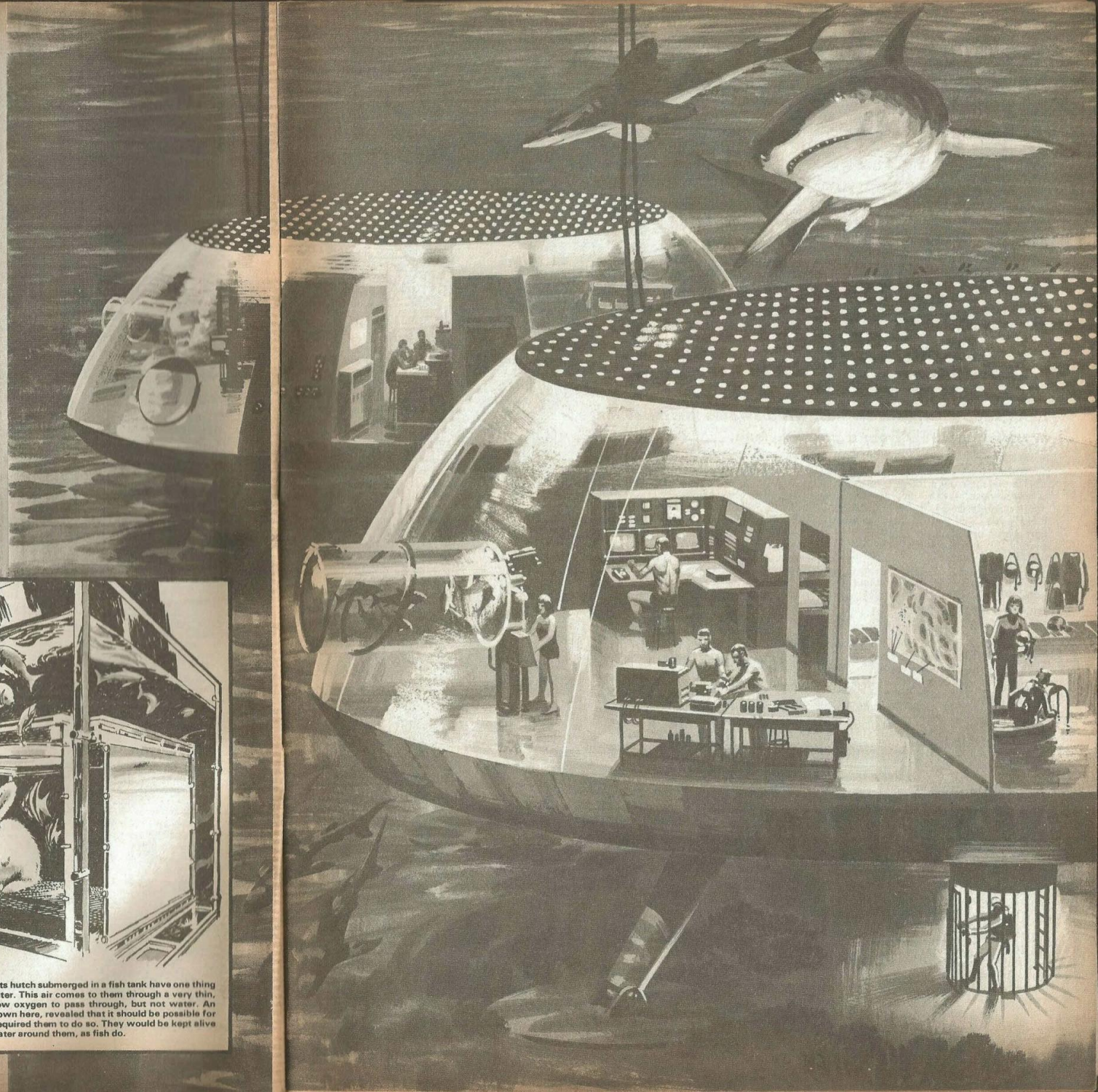
When the electron beam bombards the chemical, it gives off flashes of light. All this happens many times a second, and all the flashes we see combine together to make a recognizable picture.

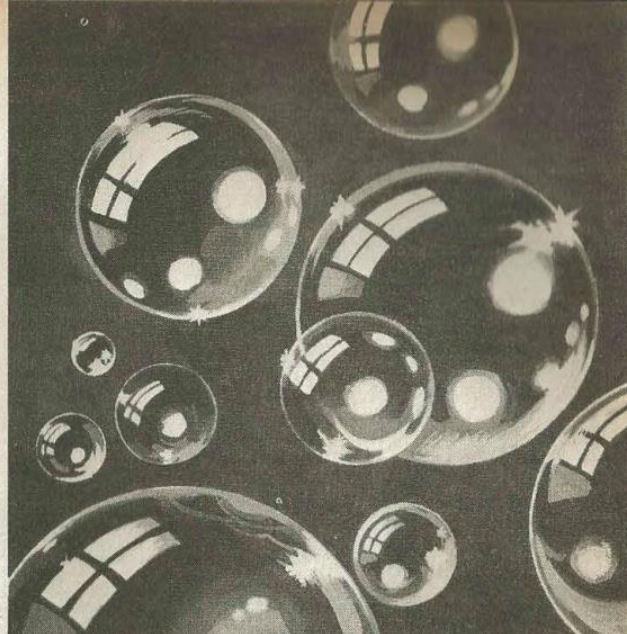
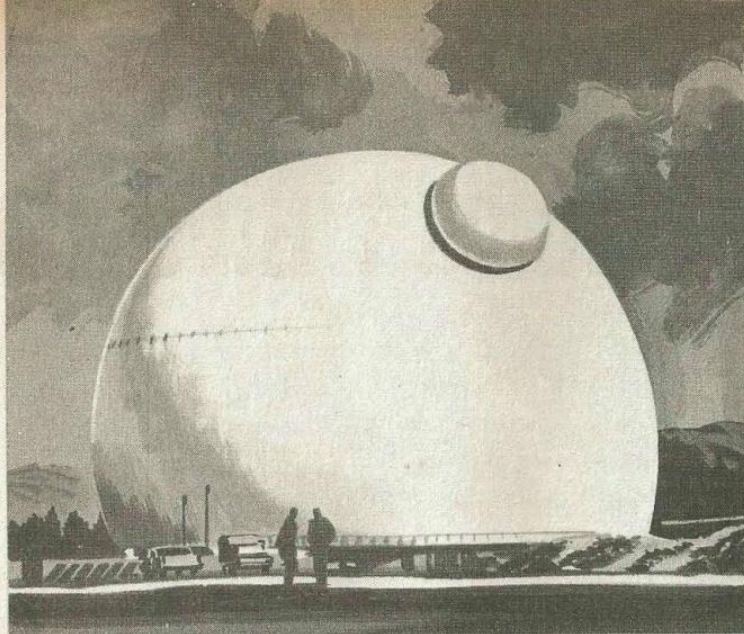
The same kind of thing, but in reverse, happens inside the TV camera in the TV studio. Here light coming from the scene being televised is focused on to a small plate of metal called *caesium*, which can

CONTINUED ON NEXT PAGE



The men in their huge spheres and the rabbit in its hutch submerged in a fish tank have one thing in common. They are breathing air from the water. This air comes to them through a very thin, plastic skin in which are tiny holes which allow oxygen to pass through, but not water. An experiment in America involving a rabbit, as shown here, revealed that it should be possible for men to stay underwater as long as their work required them to do so. They would be kept alive by breathing the oxygen dissolved in the sea water around them, as fish do.





Almost magically, millions of ethylene molecules are joined together in a huge vat. It is strange to realise that the clear polythene bags and sheets used to pack food, keep dust from clothes, wrap sweets and biscuits, are made entirely from a gas, ethylene.

change light into electricity.

This plate is truly a modern miracle of super-thinness — it hardly seems to be made of metal at all. It is so thin that it looks exactly like a gossamer-thin transparent skin of a soap bubble. And, like a soap bubble, it glistens with all the colours of the rainbow.

Colour and super-thinness seem to go together. Have you ever noticed the swirling colours in a thin slick of oil on a rain-puddle after a bus or lorry has passed over it?

Thin films act like rain-drops or glass prisms — they split up white light into the various colours of which it is composed.

The blue-tinted lens of a good camera is an excellent example of a super-thin film. And if you take the back off the camera before a new film is put in, and look through the lens with the shutter open, you will quickly see that this film or coating is not really blue at all! It simply looks blue because light *reflected* from it is split up by the coating's prism action.

BAGS OF GAS

This blue coating on a lens is also a few molecules thick. Here is how a lens is coated:

It is put into a special steel chamber from which the air has been removed or evacuated. Then a small piece of metal oxide is melted and then "boiled" inside the chamber, using an electric current. Then the oxide vapour condenses on the cool surface of the lens to form the coating.

These coatings are added to lenses to improve the sharpness of the photo by preventing undesirable light "scatter" in the pieces of glass which make up the whole lens of a good camera.

It is strange to realize that the clear polythene bags and sheets which are

used to pack food, keep dust from clothes in cupboards, wrap sweets and biscuits, are made entirely from a *gas*.

The gas is called ethylene, which burns, and can be used as a fuel. The gas is pumped into huge steel vats and then is heated along with a few slivers of a special metallic material called a *catalyst*. Almost magically the millions of ethylene molecules join together to form the tough plastic — the prefix "poly" means *many*, and "thene" is short for ethylene.

The familiar name polythene in fact describes what the plastic is made from — many (poly) ethylene (-thene) molecules.

All the time in every big city we are surrounded by thousands of super-thin films hidden away in the engines of motor cars, buses, and lorries.

These are the films of oil which lubricate the moving parts of engines.

It is not generally known that a steel axle turning around inside a tight fitting metal socket or bearing does not actually *touch* the metal bearing surface at all. No matter how tight the bearing fits the axle, a very thin film of oil separates the two. In any machine lubricated with oil, the moving parts almost literally "ride" on super-thin films.

It is incredibly difficult to cut super-thin films, particularly anything as fine as the caesium plate used in a TV camera, or the thin layers of copper used to make the printed circuits of transistor radios.

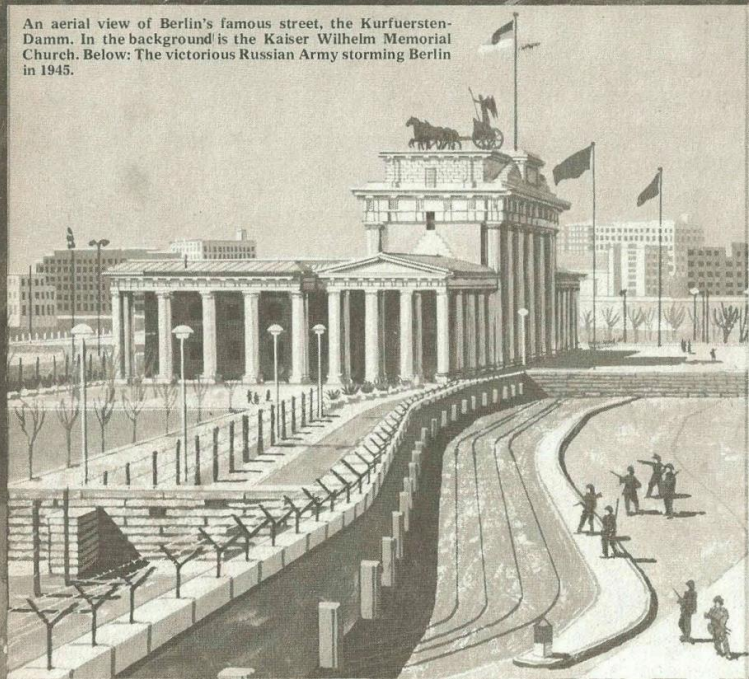
Even a small pair of surgeon's scissors or a razor blade would tear a thin film to pieces. It would be like using gardeners' shears to cut aluminium foil.

Today most very thin membranes and films can be cut quickly and cleanly by using a very fine grinding wheel edged with diamond dust. Other films are simply "burnt" away in a straight line using the beam of a laser.

Huge domes and other shapes can be made to enclose radar installations (top left), space communications equipment, sports arenas and other things. A slight increase in the internal air pressure would keep the dome's shape. The super-thin skin of a soap bubble only breaks easily because it is only a few molecules thick. Super-thin skins of oil (below) lubricate the moving parts of machines of all types. Scientists are constantly improving their oils to meet the new challenges set them by advances in engineering design.



An aerial view of Berlin's famous street, the Kurfuersten-Damm. In the background is the Kaiser Wilhelm Memorial Church. Below: The victorious Russian Army storming Berlin in 1945.



A City

Split in Two

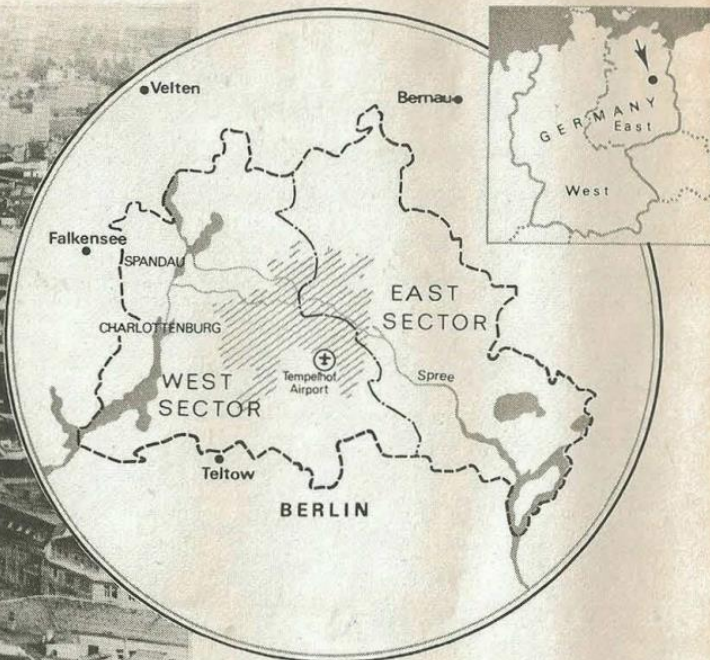
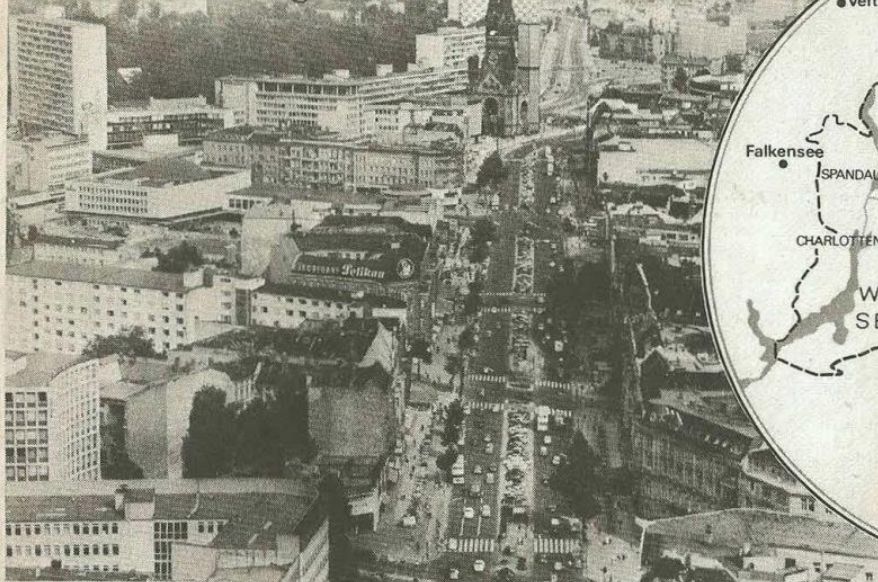
Perhaps a day will come when Berlin is not a headline city, when the wall that divides east from west is pulled down. Yet its long story goes back more than 500 years...

GERMANY, as a united country, has existed for only a century. Before 1871 it was simply a collection of provinces, states and kingdoms. From time to time one or other would be "on top," but gradually the stronger subdued the weaker; the states grew bigger and more powerful; the nation more closely-knit. The story of its capital, Berlin, really

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A glimpse of the infamous Wall at the Brandenburger Tor.



begins when the Hohenzollern family, Counts of Zollern, to the south, became rulers of Brandenburg in 1415.

At the end of the 17th century Brandenburg overwhelmed its eastern neighbour, and the Hohenzollerns became kings of Prussia, too.

They remained, and increased in power for more than four centuries. Their last ruler was Emperor of all Germany — Kaiser William II, the little man with the withered arm who drove his country into disastrous war in 1914, and ended his family's grip on the country they had largely created.

Once the Hohenzollerns made Berlin their capital, it began to expand. First it absorbed a neighbouring town, Kölln. Then "the Great Elector" Frederick William founded three more small towns: Friedrichswerder, Dorotheenstadt and Friedrichstadt, which were in turn absorbed.

Small villages, set in forests and on the borders of lakes, became suburbs. Even now Berlin has three big woodlands inside its boundaries — the Jungfernheide, Spandauer Forest and the Grunewald — and a chain of lakes.

In another suburb, Charlottenburg, a Royal castle looms, surrounded by factories. The slow waters of the Spree carry chains of cargo-barges past its spacious gardens, while in the background the huge Siemens electrical works dominates the skyline.

Each Hohenzollern king added something to his capital, but it never became a beautiful city. It had no great squares, like Paris or Rome, few dignified buildings or wide, impressive streets.

North of the Great Elector's suburb, Friedrichstadt, one of its few famous avenues, the famous Unter den Linden, runs for nearly a mile from the Royal palace to the Brandenburger Tor — a monumental gateway which now marks the division between East and West Berlin.

As in many places, the coming of the railways, and good roads, in the mid-19th century, brought an explosion of commercial prosperity. Iron, steel, cloth, carpets, locomotives, electrical equipment, sewing machines, bicycles and beer poured out of Berlin in an ever-increasing stream. The city sat at the centre of a spider's-web of communications, humming with activity.

Its cosmopolitan atmosphere attracted artists, musicians, writers, actors and journalists. It became sophisticated, and gay. But after World War I its sound took on a shrill, discordant note; its music became raucous and hysterical.

CITY OF SPIES

There was a restlessness and sullen anger abroad. One attempt had been made already, in 1848, to overthrow authority. The Hohenzollerns defeated the rebellion then. Now the Hohenzollerns themselves were gone, Berlin became a hot-bed of intrigue and political unrest.

The Depression of the '20s gave the rabble-rousers their chance. Out of the great upheaval one strong party emerged — the Nationalsozialistische Deutsche Arbeiterpartei — the National Socialist German Workers' Party — popularly called "the Nazis" — under their leader, Adolf Hitler.

On the night of February 27th 1933 the Reichstag — the German Parliament building — was destroyed by fire. A simple-minded Dutch communist, Marinus van der Lubbe, was tried, and convicted of arson. Few people believed him guilty. It was too good an excuse for the Nazis to "tighten security" and destroy all freedom. Van der Lubbe was "framed."

The last days of Berlin's happy lack-of-history were already sped. Göring, Chief of the Luftwaffe, boasted in September 1939 that

no enemy bomb would fall on Berlin. The first fell within months. In the next five years the city was blasted by more than 76,000 tons of explosives and fire-bombs. Not much, by modern standards, but enough to leave it a heap of smoking ruins — its people living in cellars under piles of dusty rubble, like cornered rats.

After the war the victorious Allies: Britain, France, America and Russia, divided Germany into four separate Zones, which their armies policed. Berlin fell 105 miles inside the Russian zone.

But this was the capital of all Germany — the west was not content to let it go entirely to the east. A line was drawn roughly down the centre of the city — and the two halves fell apart.

One half became capital of the Eastern Democratic Republic. The other, a tiny island of the Western Federal Republic, attached to its mother-country by twelve tenuous threads: four roads, four railway lines, three narrow air corridors and one waterway — all of which could be closed by the Russians at will.

It was impossible to rule the Federal Republic from this precarious capital. The government of West Germany moved to Bonn. But West Berlin remained fiercely "western." West Berliners looked forward steadfastly to the day when they would once more become citizens of a capital.

Meanwhile their little "island" became a pawn in the cold war — a stick to threaten the western Allies. Berlin became a city of spies, and intelligence services — of kidnappings, disappearances, whispers, and bugged hotel rooms — a setting for real-life adventure more exciting, and dangerous, than any novelist could imagine.

In 1948 things reached a climax. The Russians closed all land-communications with the allied zones, and West Berlin was cut-off — threatened with starvation.

The allies mounted a gigantic Air Lift of vital supplies. For nearly a year a constant stream of planes flew down the narrow air corridors on this hazardous mission, constantly buzzed by Russian aircraft — but they kept the lines open, and the Russians ultimately gave in.

The unease grew. West Berlin was staggering back to its feet, beginning to prosper. By contrast with the sombre east, it was rich, and gay. East Germans began to desert across the dividing line. In dozens, in scores, in hundreds, in thousands. In the five years before 1961 the amazing total of one and a quarter million people fled to the west — mainly West Berlin.

The East became short of manpower. Something had to be done.

It was. One day in the summer of 1961 Berliners woke to find a barbed-wire barricade between the eastern and western zones. Soon the notorious Berlin Wall began to rise.

Families suddenly found themselves separated; only streets apart, but living in different countries — different worlds — with no communication except occasionally, at the whim of Soviet authorities.

"Defections" slowed to a trickle, but they did not entirely cease. Tunnels were dug, canals swum in the dark of night. People jumped to freedom from third and fourth storey windows along the boundary line.

The houses were demolished — a no-man's land was created on the eastern side of the wall, watched over by vigilant, trigger-happy sentries in tall towers.

This is Berlin to-day — a glitteringly bright and prosperous but nervous West, a subject east. A capital without a country. An island, surrounded by land.

The news early in 1972 is that West Berliners will be able to visit friends and relations in East Berlin 9 times a year. Is this a sign of better times ahead?

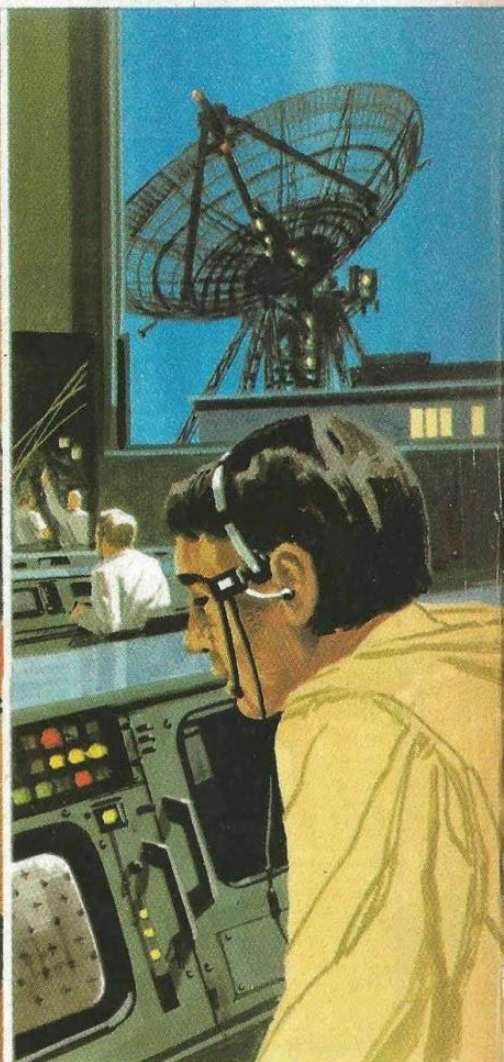
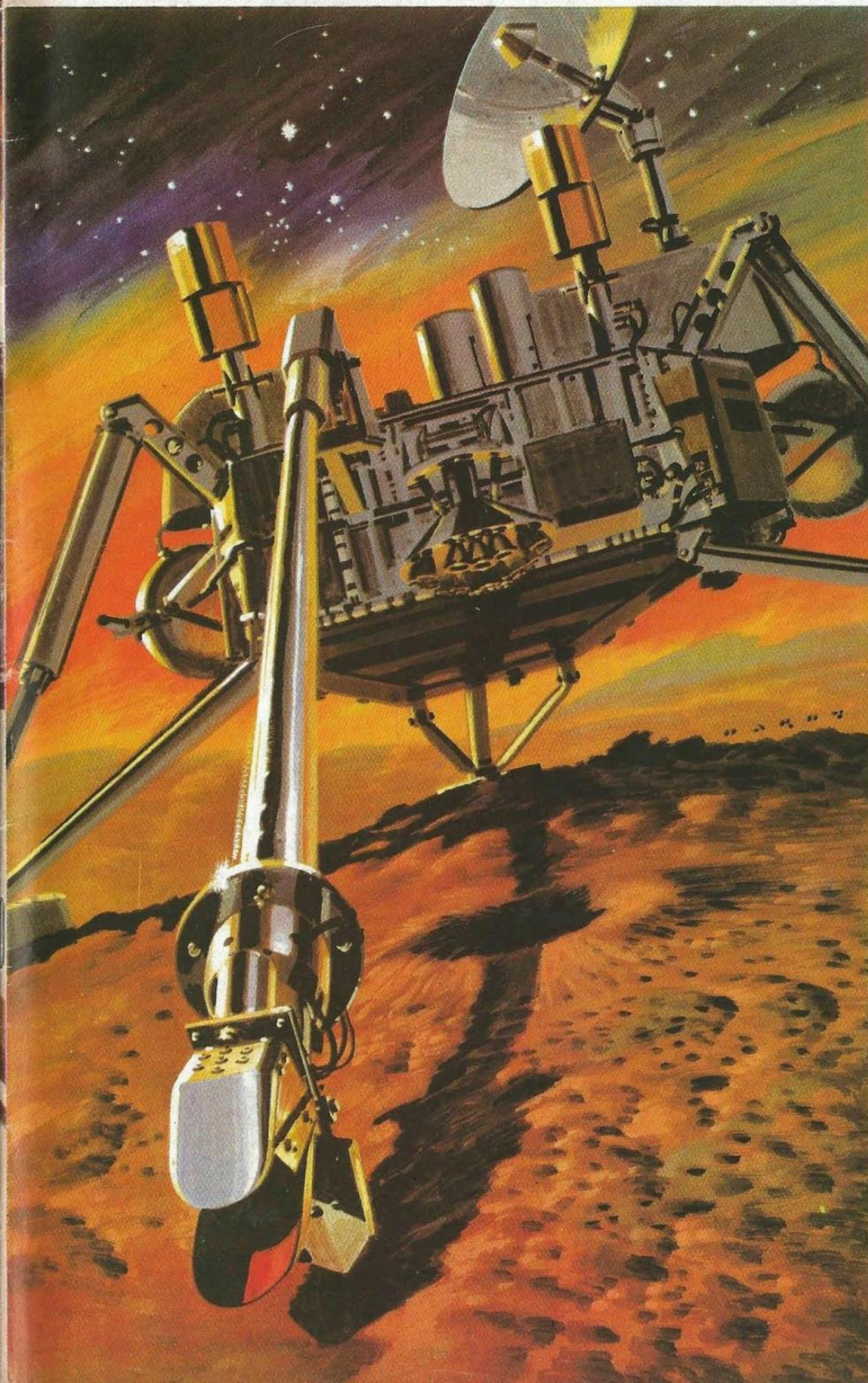
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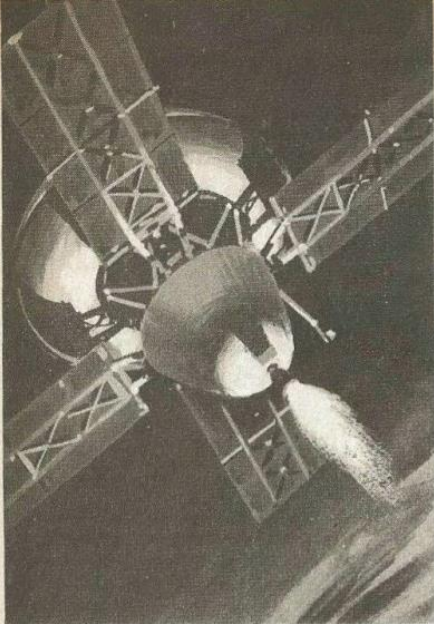
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VIKING'S MISSION TO MARS

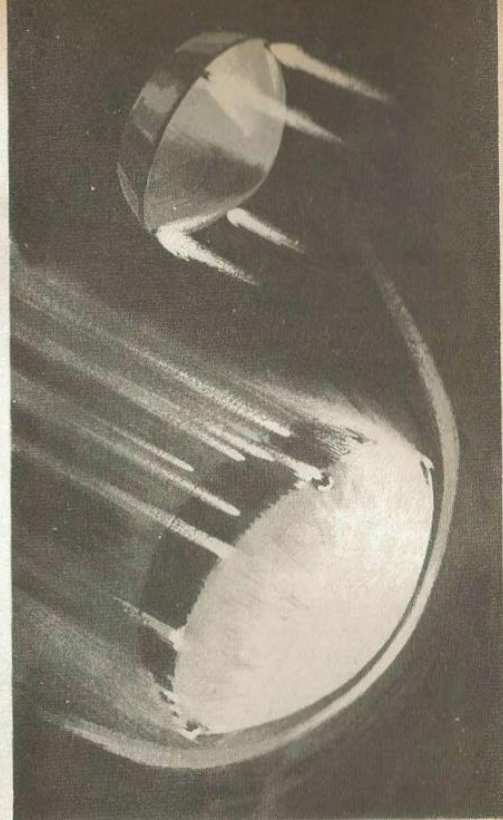
SEE INSIDE



After a flight of almost a year, the space-craft fires its retro rockets to place itself in a wide, looping orbit around Mars, all the time closely monitored on Earth to which it is constantly transmitting essential information.



Having studied the surface of Mars in detail for up to 50 days and sending back pictures to Earth, the orbiter picks a warm and wet landing place. After releasing the complete landing capsule, the orbiter functions as a relay.



The retro rockets of the lander capsule fire (upper) and it drops down out of orbit to enter Mar's atmosphere at 800,000 feet, protected by its heat shield (lower). This landing is a vital part of the mission and great care is being taken to ensure its success.

AN inquisitive mechanical eye is going to take a look at the planet Mars in a few years' time. It will take nearly 12 months to get there, and it will float around the planet for 50 days before it lands to explore the mysterious world on the other side of the sun.

What it will find there will not be known until 1975. Then, the Americans will send their "eye," in fact, a Viking spacecraft, into orbit around the earth as the first stage of its flight. Launching it will be a Titan booster with a Centaur upper stage to shoot the Viking off on its course for its 430 million mile journey.

Mars will be reached when it is about 210 million miles from earth on the other side of the sun after a long interplanetary cruise.

By this time the spacecraft will have separated from its Centaur booster, arriving as a 5,000 pound mother ship and a lander of 2,400 pounds.

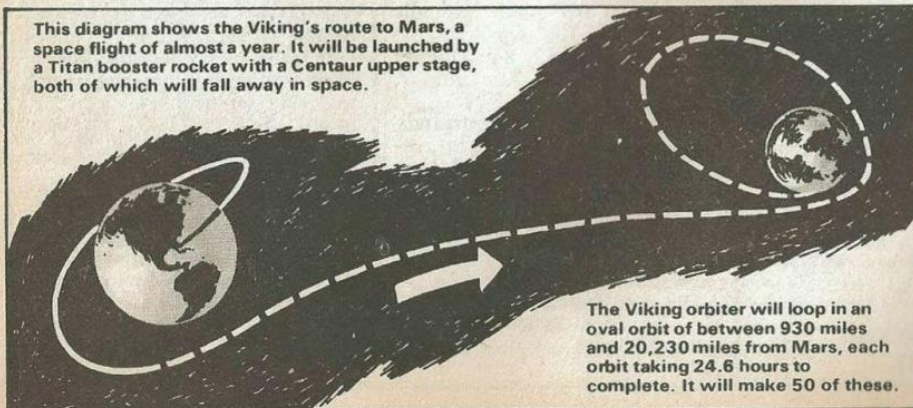
Before any attempt is made to land on Mars, the mother ship and the lander, docked together, will orbit Mars for 50 days to study the surface to find a suitable landing site.

Scientists are hoping to find a warm, wet surface to give them a soft landing. Their landing system is similar to that used by the Russians whose Mars 3 touched down successfully on the planet's surface.

LOOKING INTO SCIENCE

VIKING'S MISSION TO MARS

This diagram shows the Viking's route to Mars, a space flight of almost a year. It will be launched by a Titan booster rocket with a Centaur upper stage, both of which will fall away in space.



The Viking orbiter will loop in an oval orbit of between 930 miles and 20,230 miles from Mars, each orbit taking 24.6 hours to complete. It will make 50 of these.

But the Russian capsule only survived to transmit data for about 20 seconds. Does this mean that some unknown factor put it out of action? Will Viking meet a similar fate?

Who knows? The Americans are not worried. The fact that the Russian capsule landed at all has bolstered their confidence that all will be well.

They have been busily planning and making all the equipment to go into the lander.

This will include a camera to send back panoramic views of the Martian surface in both black and white and colour.

Apparatus will analyse the soil and atmosphere for signs of life.

Recorders will store and transmit data from the lander.

Touchdown and landing radar will ensure a relatively soft landing for the capsule.

A special propulsion system has been made for the last leg of the landing.

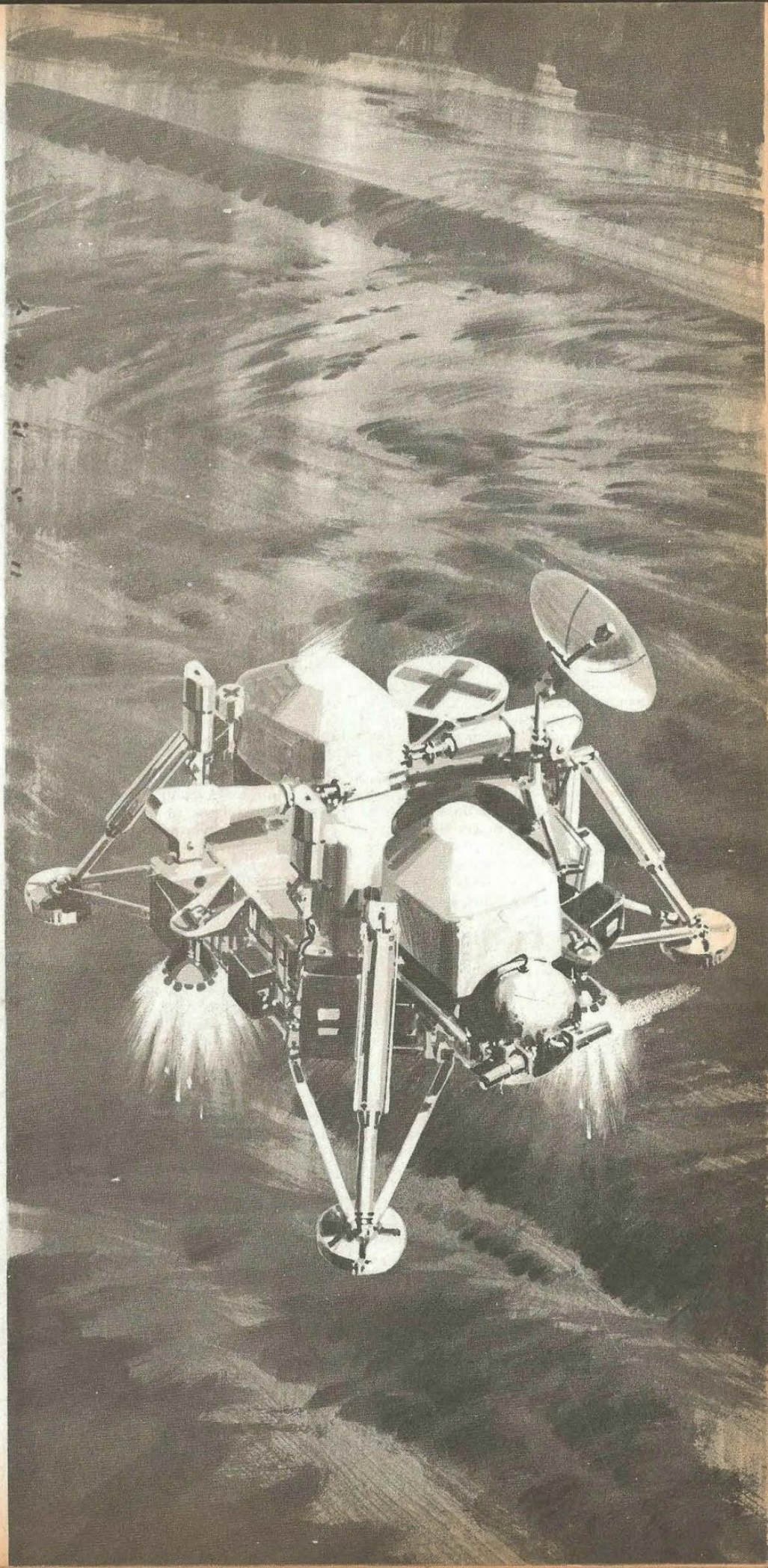
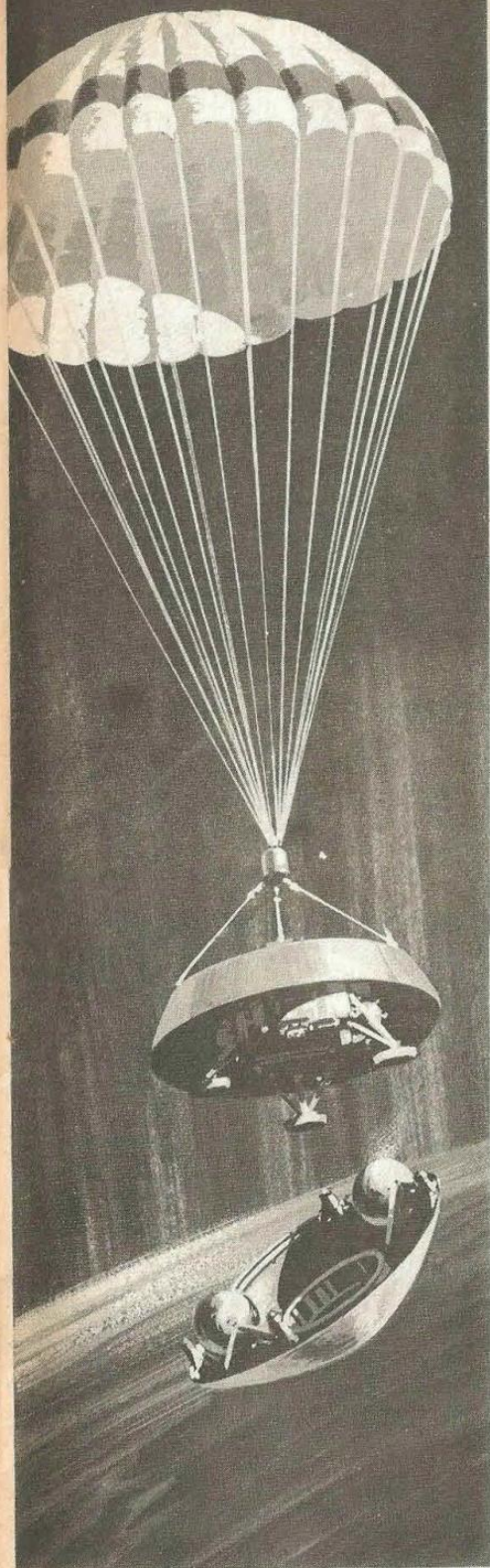
Parachutes are being made for use in the unknown Martian atmosphere as part of the landing system.

A mass of equipment will also be installed in the orbiter. This will send back television pictures of the Martian surface as it swings about the planet in an oval orbit. An atmospheric water detector will help in the choice of a landing site that may be capable of supporting recognisable life.

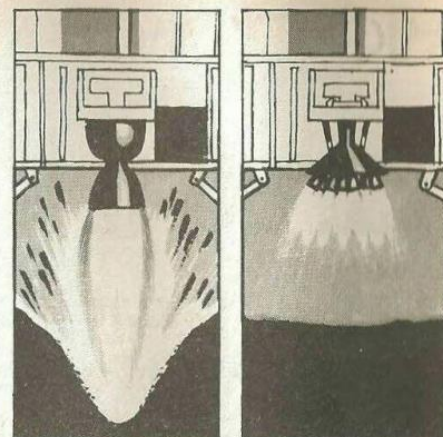
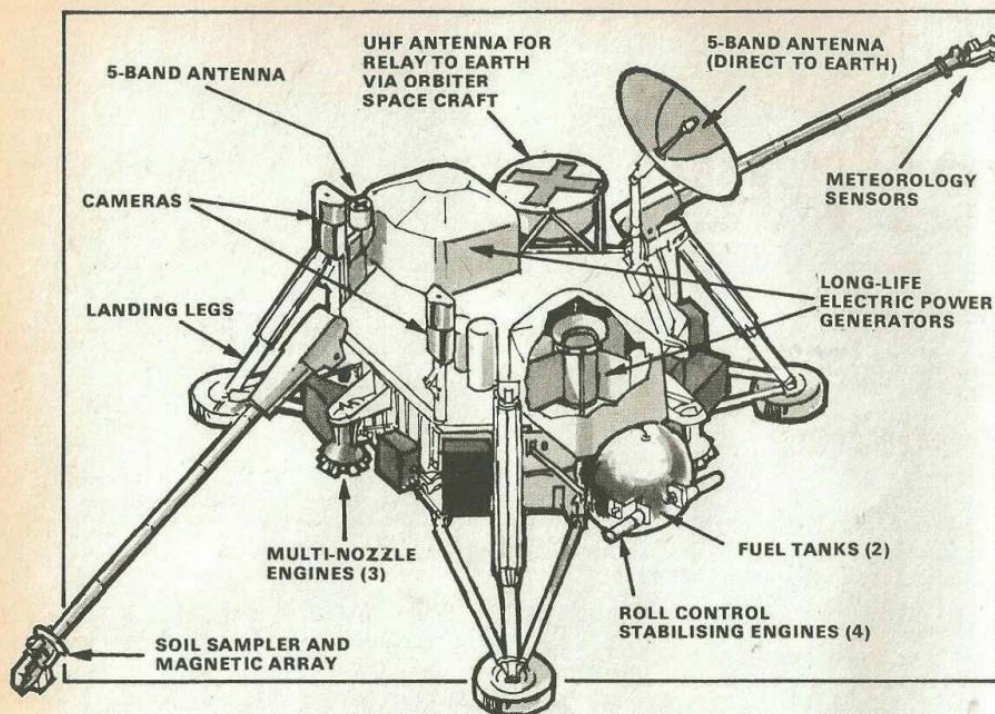
A third instrument, called an infra-red thermal mapper, will look for warm areas for the landing.

Great care is being taken to make sure that the landing goes off without difficulty.

CONTINUED ON NEXT PAGE



At 20,000 feet, having done its job, the heat shield drops away, exposing the lander for the first time (above). At 5,200 feet, the lander is released and is on its own for the final descent, which takes five to ten minutes (right). It is slowed and cushioned by its three multi-nozzle rocket engines. Each of these engines has 18 jets to lessen the disturbance to the Martian soil. Radar will be used to ensure a relative soft landing to protect the vital instruments carried in the landing capsule. Should these be damaged by the descent, this mission to the unknown planet beyond the sun could be a failure.



Some of the features of the lander can be seen on the left. A close-up of its soil sampler scoop is shown on the front cover of this issue. The picture above demonstrates the reason for each of the three rocket engines having 18 nozzles. Single nozzles were found to dig a hole three foot in diameter and 1.5 foot deep in a model of Martian soil. Engines with as few as six jets and as many as 24 jets were tested before the assembly of 18 nozzles was found to be the best.

Below are the main components of the Viking space vehicle.

- A. The bioshield cap.
- B. The aeroshell cover and parachute housing.
- C. The lander.
- D. The aeroshell base and heat shield.
- E. The bioshield base.
- F. The orbiter.

The object of the bioshield is to lessen the contamination of Mars by the lander, which will also be sterilised.

If it is necessary for the mission controllers to correct a big mistake, the problems of communications over the millions of miles between Earth and Mars, will be terrific.

Suppose, during the landing, a correction is necessary, it will take 40 minutes before the spacecraft signal reaches Earth and a command is returned to Mars.

The job of the orbiter will be to act as a relay station for much of the data recorded by the lander. Although the lander can send back directly to Earth, it will do so at a much slower rate. In the end, however, the lander will be linked directly to Earth because it will stay active for much longer than the orbiter.

The orbiter is designed to operate for 50 days before the landing and for 90 days afterwards, but it may last for longer. Scientists would not be surprised to see the lander active for months or even years, although some of its experiments cannot last that long.

VITAL LANDING

Its weather station should operate for a long while, and there is no reason why the seismometer should not send back data about tremors in the Martian surface for some time.

Hopes are high that the lander will keep going at least long enough to send back pictures of the seasonal changes, which occur at six-monthly intervals on Mars.

"The difference between having an orbiter," said a scientist, "is that with it we can get twenty pictures a day, without it, one. But after ninety days of pictures, I'm not sure what we'd do with very many more."

The reason that the lander will stay active for so long is that it will be powered by two devices which convert heat into power. These are radio-isotope thermoelectric generators. This is the kind of equipment that was used for the Apollo

lunar surface experiments. Apparatus left on the Moon by the Apollo 12 crew is still sending data to Earth through power supplied by the conversion of heat.

Eighty scientists are going to be at work during the mission, the majority with the lander experiments.

These will be using the camera for close-up and distant pictures. Images will be transmitted back to Earth by electronic signals and converted to a light that will be recorded on film and developed as a negative.

Biologists will be trying to find if organisms exist on Mars to see if there is life. They will also study the soil.

One very complicated device will "sniff" the Martian atmosphere, and also analyse the gases given off by soil samples collected by an automatic scoop and heated to a temperature of 500 degrees Centigrade.

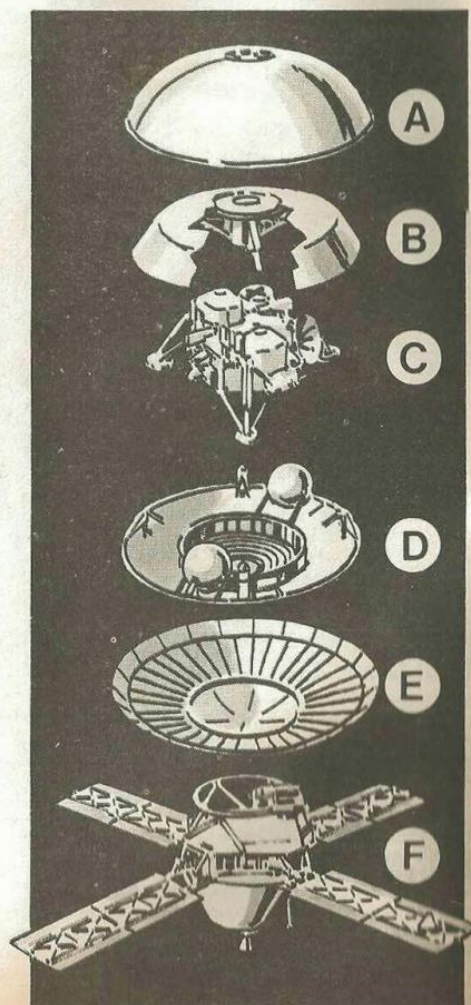
Sensors will find out what the Martian air consists of, and other apparatus will make daily measurements of temperatures, pressures and humidity as well as wind speed and direction.

Cameras aboard the lander will take pictures of the footprints left by the craft after landing and of the trough made by the surface sampler as still another measurement of the properties of Martian soil.

Despite all this advanced scientific equipment, the whole mission could fail if the landing was a bad one. Parachutes will float the lander to the surface. But nobody knows how they will behave in the Martian atmosphere or how the cloth of which they are made will stand up to almost a year in space.

Another point is that the orbiter can only send back pictures which show detail on Mar's surface of objects the size of a house.

If the lander crashes down among boulders too small to have been detected, years of working and hoping will be wasted.



LOOK LEARN

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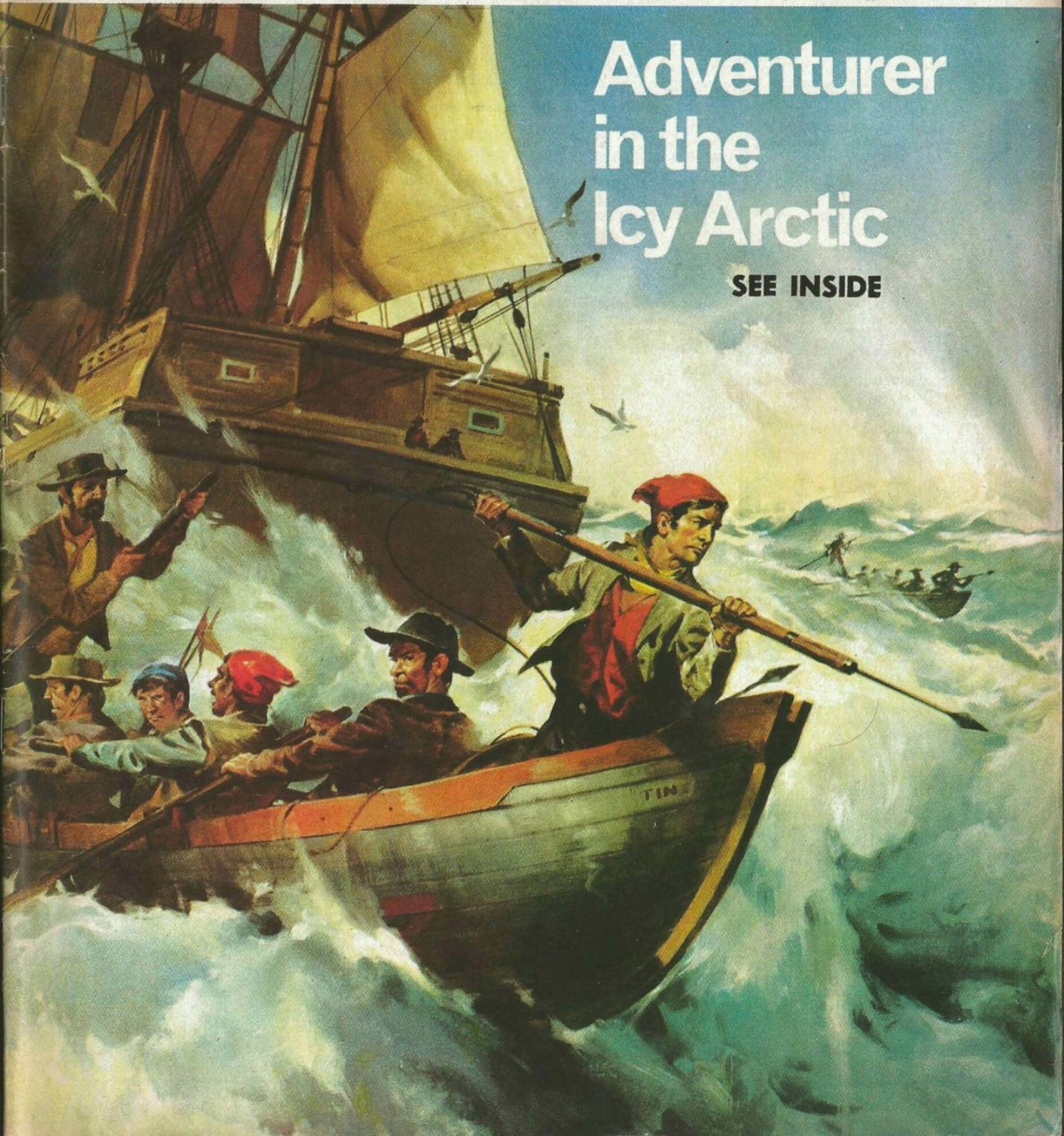
No. 533. 1st APRIL 1972

EVERY MONDAY 10p

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Adventurer in the Icy Arctic

SEE INSIDE





LOOKING INTO SCIENCE

THE MEN WHO MAKE STORMS

WHAT WOULD happen to ships sailing into the English Channel if a gigantic landslide were to block the Straits of Dover? How might Danish weather be changed if a huge tidal wave were to flood the whole of Holland?

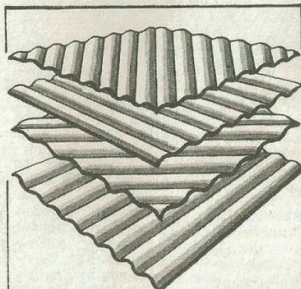
Most scientists might do little more than make a reasonable guess at the results of these disasters, based upon similar things that have happened in other parts of the world.

Dr Ishiguro could tell us almost exactly what would happen. And he would do this in a surprising way — by making these catastrophes take place, and then observing the results.

They would not *really* happen, of course. Dr Ishiguro has made himself a model of the North Sea and the countries surrounding it. With this model he can do just about anything. He can build a bridge of land connecting England with France. He can make an island appear just off the Belgian coast. He can fill in the Irish Sea. After doing all this Dr Ishiguro carefully watches and measures the strange thing which could then happen to the tides, the winds, and the ocean currents.

Surprisingly, his model is *not* a

Sitting safely in laboratories on land, scientists can simulate undersea earthquakes, tidal waves, floods and hurricanes—just by pressing a few buttons.



This "sandwich" model shows the complex wave patterns which exist deep down in the sea. It is the lack of data on these which makes ocean forecasting difficult.

miniature relief map of plaster surrounded by water in some sort of shallow pan. It is simply a large metal box filled with miles of wiring connecting hundreds of electronic parts. It is a special type of machine which scientists call an *analogue computer*. The word *analogue* comes originally from Greek, and roughly means "in proportion to size." In Dr Ishiguro's machine the strengths of winds, tides and ocean currents are represented by the strengths of electric currents. By turning certain knobs he can make the electric currents match exactly the wind strengths in the North Sea. Then by changing these electric currents he can imitate the changes which could occur during some disaster. The results are then observed by watching a number of measuring dials.

CONTINUED ON PAGE 6



These results can be also used to draw a series of maps of the whole area.

Dr Ishiguro is an *oceanographer* — a scientist who makes a special study of the oceans of the world. And there are many more like him, for today oceanography is one of our new "space-age" sciences.

It is also a *difficult* science, for a number of very special reasons.

To start with the oceans are so *big* — they cover about 70 per cent of the Earth's surface. And the ocean can be much deeper than the land is high. If Mount Everest could be sunk down into the famous Marianas Trench near the Philippines in the Pacific, more than a mile of water would cover its summit.

Even the amount of salt in the oceans, if taken from all the sea water, could cover all the land in the world to a depth of more than 400 feet.

It is relatively easy for scientists to study the land — they can walk over it and look at it. Better still, large chunks of it can be viewed from a satellite.

But most of the 300 million cubic miles of sea water in the oceans are hidden from sight. And although scientists have sailed in ships across the ocean surface thousands of times, and made hundreds of trips down into the depths in diving suits and special submarines called "bathyscaphes," they have hardly seen anything of the oceans as a whole. It is very much like trying to study an entire stretch of coastline by merely looking at a few tiny grains of sand through a microscope!

That is why the most modern way of studying the oceans is by simply making *models* of them. This is what engineers and architects do. Before building a new type of racing car or supersonic aircraft they first make a model, and give it various tests to see how it will work.

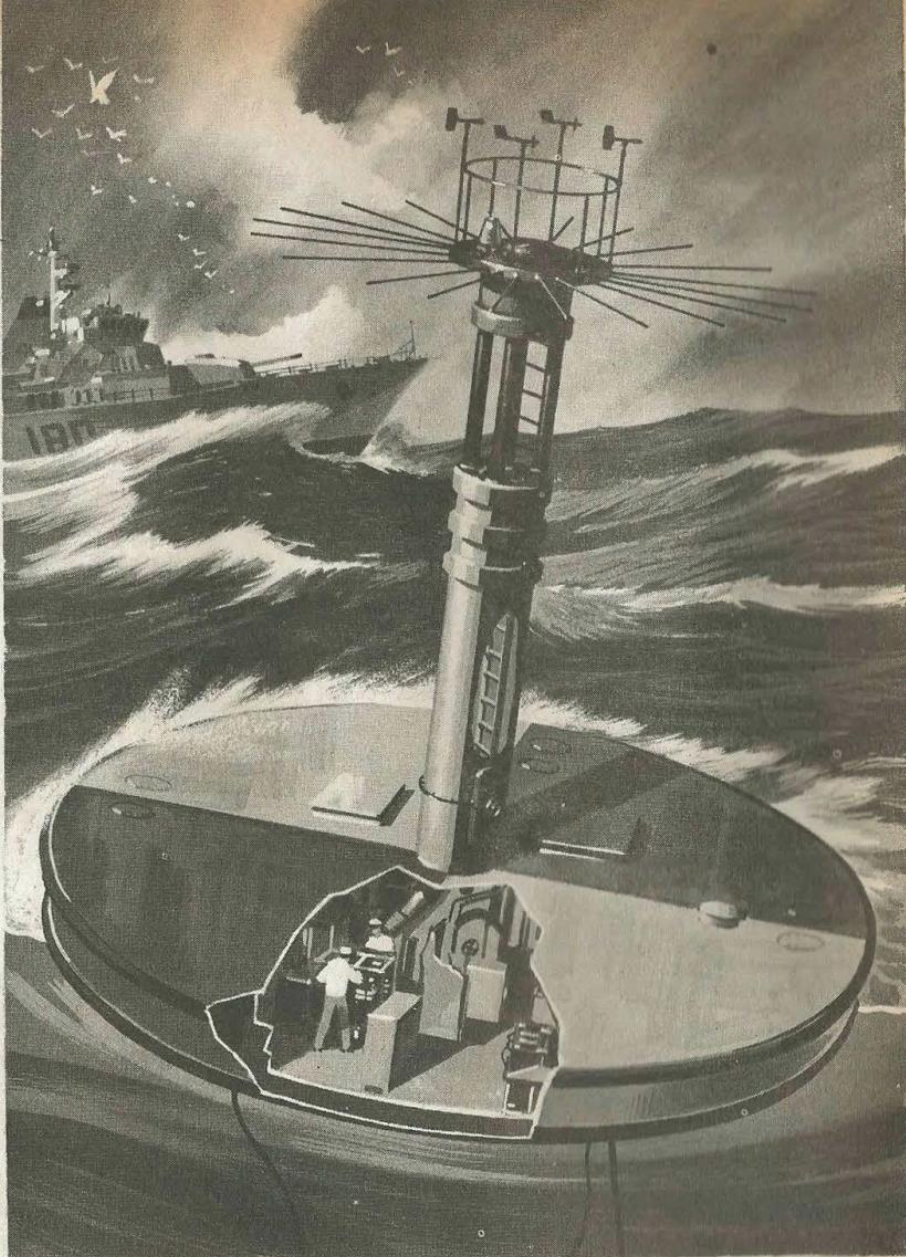
Dr Ishiguro's electronic model of the North Sea is just a "model of a model" — other scientists who are also oceanographers are now starting to build very large analogue computers which will model all the oceans of the world. They will be very complicated and contain thousands of transistors and other electronic parts.

MOON POWER

The oceans are temperamental — even scientists and weather forecasters are never sure what they may be up to at any given moment. Within minutes a calm sea can erupt into a violent storm, which can then die away in less than an hour, or it may rage on for days.

Perhaps few of us realise how much the Moon and the Sun have to do with ocean movements.

The force of the Moon's gravity is constantly pulling at the Earth, and to a lesser extent the gravity of the more distant Sun does the same thing. This makes the water in the oceans "bulge" out round the Earth's equator, causing



Huge sea stations like these will soon be moored in oceans all round the world. Filled with electronic equipment, the unmanned buoys will transmit information about wind, waves, ocean temperature and currents and many other facts to weather men hundreds of miles away. Computers will analyse the data and from this experts will be able to predict the weather to come many days in advance.

the tides to rise and fall regularly.

Besides the force of the Moon's gravity the oceans are also set into motion by earthquakes taking place far below the surface.

The Sun's heat causes winds to blow as hot air rises and cold air falls, and this also moves the sea surface. And the Earth, as it turns, gives an extra push to the already restless sea. In fact the waves seen (and experienced!) on the surface only tell a small part of the story. Below the surface other waves are moving in several different directions at once, layer after layer of them, like slices of bread piled up on a plate.

So complicated are the movements of water in the world's oceans that many scientists used to despair of ever being able to make accurate forecasts of ocean conditions, even though ordinary weather forecasting had become accurate enough

to be really called "science."

Today the situation is changing. Accurate "ocean forecasting" will soon be possible with the help of computers.

But computers must have information to work with. They must be *programmed*.

Plans are now afoot to launch thousands of "floating saucers" on the world's oceans. These are giant disc-shaped buoys which can weather hurricane winds and 100-foot waves. Each buoy will be powered by atomic-energy "batteries" which will run its electronic equipment. On top of each buoy a radio antenna will send information about ocean waves and currents to distant laboratories, which will then be "fed" into computers. These "electronic oceans" will be able to send out forecasts enabling experts to predict what the weather will be like many days in advance.

LOOK LEARN

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No. 535 15th APRIL 1972

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War In The Air - On The Ground

see inside



A black and white photograph of two fighter jets, likely F-4 Phantom IIs, in a steep climb. The jet in the foreground is seen from a low angle, showing its cockpit with two pilots, its wings with a large white star insignia, and its engines. The second jet is positioned above and slightly behind the first, also in a steep climb. The background is a bright, hazy sky with some light streaks, suggesting high speed.

WAR IN THE AIR— ON THE GROUND

Climbing, diving, banking and rolling—these fighter aircraft engage in high-speed combat, using manoeuvres their pilots have practised in an amazing flight simulator—a machine which reproduces all the sensations of flying without the pilots ever becoming airborne!

PILOT IN SECOND DOME SEES BACKGROUND WITH AIRCRAFT OF OPPOSING PILOT PROJECTED ON TO THE SIDES, CEILING AND FLOOR.

PROJECTOR GIVING ALL ROUND PICTURE OF SKY AND GROUND WITH 360 DEGREE MOVEMENT LINKED TO PILOT'S CONTROLS

PROJECTED IMAGE OF OPPOSING AIRCRAFT

STEEL DOME

TEST DIRECTOR AT CONTROL CONSOLE

COMPUTER PROGRAMMED FOR AIRCRAFT TYPES BEING USED

STATIONARY COCKPIT WITH A SEAT WHICH VIBRATES SLIGHTLY TO WARN PILOT OF IMMINENT STALL

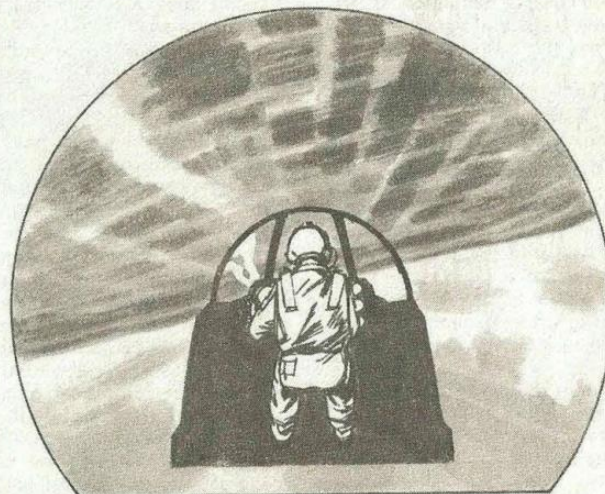
MODEL AIRCRAFT AND ZOOM LENS CAMERAS TO PROJECT MOVING IMAGES INTO OPPOSITE DOMES

WITH a mighty roar from its afterburners, the jet fighter surges forward in pursuit of the enemy aircraft some 9,000 feet in front. Too late, the enemy pilot tries to take evasive action, twisting, diving and climbing through the sky in an effort to shake off his pursuer. But the fighter pilot has more skill and his aircraft has the edge on performance over his adversary. In a last, desperate manoeuvre the enemy pilot goes into a steep bank to the left, but his pursuer makes an even tighter turn and as the enemy aircraft falls across his gunsight, he registers a "kill."

This sounds like an account of an aerial fight over some war zone but, in fact, neither the "enemy" pilot nor his pursuer were airborne at the time! The entire dogfight took place on the ground — inside an amazing machine called the Dual Manoeuvring Simulator (DMS).

Developed by the National Aero Space Administration (NASA), this complex fight simulator permits virtually any two aircraft to be flown in mock combat with a very high degree of realism for the pilots — even though they are sitting still! Basically, the machine consists of two 40 foot diameter steel spheres, each of which contains an aircraft cockpit with a light projection system mounted over the top. Outside the spheres there is a control panel for the test director, two model studios where replicas of the aircraft being flown are photographed by television cameras, and two computers which control the DMS system.

The cockpits inside each sphere are fixed and to create an illusion of movement for the pilots, it is the sky, horizon and land projected on to the



A very high degree of realism can be given to the pilot's "flight" inside the simulator dome. The projector which throws a picture of the sky, horizon and landscape on to the dome's inner surface can be revolved through 360 degrees so, as the pilot rolls his "aircraft" over on its back, the picture turns over to give the pilot the impression that he is flying upside-down!

CONTINUED ON NEXT PAGE

inside of the sphere, which moves up, down, from side to side and even upside-down!

Surprisingly, the pilots respond to this "false" movement in a very real way, tensing themselves as they go into steep turns and dives, and even suffering tired neck muscles from instinctively bracing their necks against the high "G" forces which they would experience in a real aircraft. After only a few minutes "flight" in the simulator the pilots are so taken in by the realism that they will instinctively grab for loose pens in their top pockets as they "roll" the aircraft on to its back for inverted flight. In fact all that has happened is that the landscape has turned through 180 degrees!

SKY HUNTING

During mock dog-fights the pilot in each sphere sees a replica of his opponent's aircraft projected on to his own landscape. This allows him to take the role of the hunted, or enemy aircraft, and the other to play the hunter, or intercepting aircraft. Inside the model studio the zoom lenses on the television cameras spiral in and out in response to the pilots controls, making the projected aircraft seem up to 46,000 feet apart or as close as 300 feet. Changes in altitude, and turns, dives and climbs are faithfully reproduced by the models and projected on to the insides of the opposing spheres.

The two computers which control the DMS system have been fed with the correct flight data for each type of aircraft used on the simulator. If, for instance, one of the pilots goes into a turn that is too steep for the type of aircraft he is "flying," the computer will simulate an "overshoot," indicating to the pilot that he has "overdone" things and in real life this particular aircraft would be incapable of such a manoeuvre.

This information for the computer has been taken from the actual flight performances of the chosen aircraft. Pilots who have flown in both the real aircraft and on the simulator say that the DMS corresponds very closely to the flying characteristics actually experienced.

The DMS has several exciting possibilities. First of all it can give pilots advanced training in the art of "dog-fighting" with high-speed jet aircraft. Known data on the performance of fighter aircraft used by a foreign power can be fed into the computers to control a replica in the model studio,

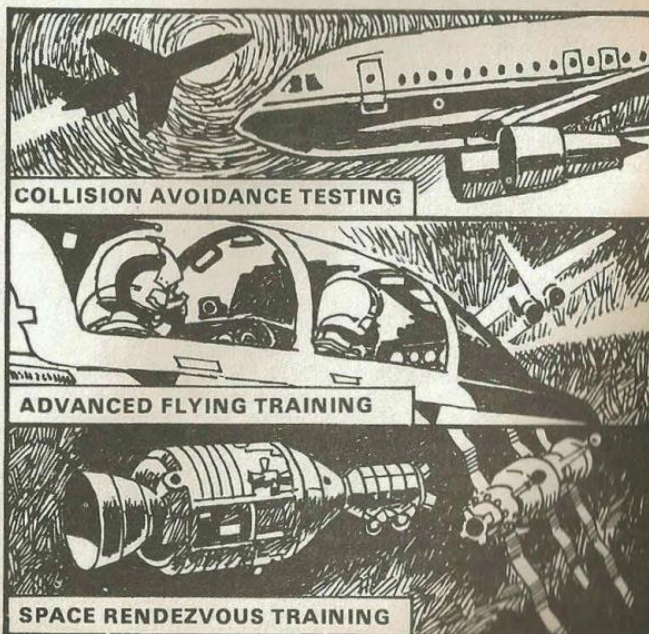
thus enabling a pilot to get combat experience without ever having to "fire a shot in anger" at "enemy" jets.

Using the DMS designers will now be able to create new aircraft that are fully operational and match all the performance standards required before the design has even left the drawing board. Normally, after a prototype has been built, modifications are needed to make the new design match the performance of rival aircraft. This can take considerable time and expense but now, by feeding data on the new design into the computers of the DMS, mock battles can be staged with rival aircraft and the performance evaluated and modified before the prototype has even flown!

The DMS will also be of great use in the field of civil aviation. Using the simulator, airline pilots will be able to practise collision avoidance, a growing problem in our already overcrowded skies. Simulated "bad weather" flying can also be experienced by changing the lighting inside the steel domes.



Above: In real air combat a jet pilot experiences severe "G" loads, or centrifugal forces, while pulling his aircraft round in tight turns as he strains to keep his opponent in view. Though the cockpits of the simulator do not move, the pilot's "flying" in them experience all the sensations of violent high-speed flight and emerge from the simulator feeling as though they have been in a real dogfight! **Below:** Collision avoidance testing, advanced training, and space link-ups are some of the other procedures pilots can practise on the amazing DMS machine.



LOOKING INTO SCIENCE

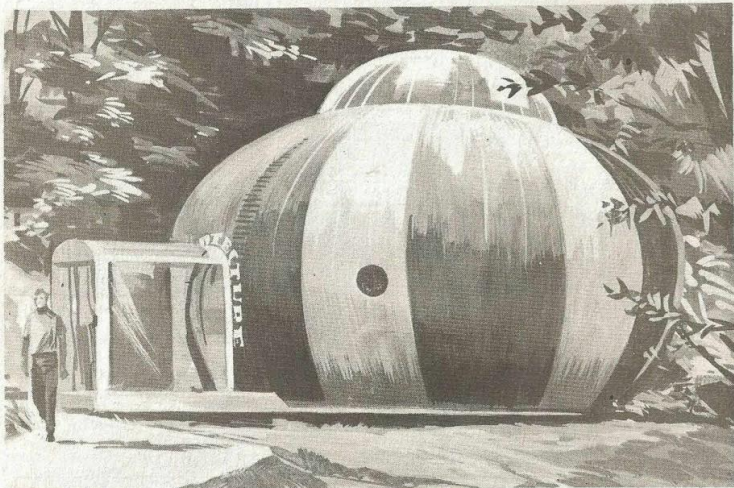
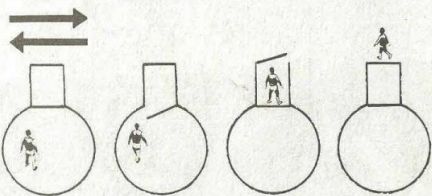


Diagram showing the principle of the air-lock used in the inflatable house. To leave the "balloon house" read the diagram from left to right. To enter the house read the diagram from right to left.



The inflatable house (top) could bring about a revolution in temporary housing. Easily transported and erected such houses could be used as emergency shelter after an earthquake disaster, as temporary living accommodation for construction workers, or simply as a more luxurious form of tent for people on holiday.

The immense strength of modern plastics can be put to good use in another type of "balloon," which this time is being used to store an emergency supply of water for a town where there is a seasonal water shortage. Artificial reservoirs like this can be filled with a million gallons of water—enough to supply a small town for several weeks.



HAVE HOUSE WILL TRAVEL

A house you can inflate and move into in minutes, a million-gallon "balloon", the golf ball which never gets lost and a device which could make your transistor radio worth its weight in gold! These are some of the developments in the fields of science and engineering which we take a look at this week.

BLOW-UP homes — that's the latest idea for people who are always on the move, or week-enders who really want to get away from it all. Easily transported and erected, these new "balloon houses" are roomy and weather-proof, and could easily replace tents for those who like their outdoor life to have an air of luxury.

Made from thin but durable plastic, the "balloon" house

comes complete with windows and a door and once the owner has found a suitable site to set up home, he simply connects his plastic house to an air pump and stands back. In a very short time the house is inflated and ready for use.

There was one special problem that engineers had to overcome when designing the inflatable home. How could people get in and out without letting all the air escape?

The problem was solved by fitting the "balloon" with a small plastic porch containing two doors. To get out of the house, the occupant opens the inner door and closes it, allowing a small quantity of air to be trapped in the porch. Then the second door to the outside is opened and closed and the air inside the porch escapes. Getting in is the reverse procedure and the small amount of air lost each time is easily replaced by the air pump.

AIR-HOUSE

The correct scientific name for a two-door porch like this is air-lock. The same principle is used by astronauts on Moon journeys so they can move from their space capsule into the lunar landing craft.

The air pressure needed to keep the house inflated is only slightly higher than that of ordinary atmospheric pressure. When the time comes for the owner to leave, all he has to do is let the air out of his house, roll up the plastic "balloon" and put it into the boot of his car before driving to another site.

A huge plastic balloon was also the answer to the problem of an acute water shortage in the town of Little Rock, Arkansas, USA. A huge plastic balloon made from polythene plastic, the same type of plastic that is used for making raincoats, shower curtains and food containers, was set up on a large area in the town.

WATER STORE

At a time when water was plentiful, the huge balloon was connected to the mains supply and filled with a million gallons of water. When the dry season started the citizens used the emergency supply for washing and drinking. It was also more than useful for use if fires broke out.

When the water shortage was over the artificial reservoir was emptied and packed away, taking up no more room than a large crate.



Top: Launching a large plastic "egg" containing electronic instruments and a magnetic compass which will be used to study wind directions far out in the Atlantic.

KEEPING TRACK

HERE is another unusual use for plastics in this modern age. This huge "egg" does not contain an equally huge chick. It contains complex electronic equipment, including a radio transmitting station in miniature. Swiss meteorologists have "launched" this plastic egg on the high seas so it will drift across the Atlantic, blown this way and that by the winds. Inside the egg is a special

magnetic compass which is connected to the radio transmitter. Every time the egg changes course the new direction is indicated by the compass, and this information is sent by radio to the meteorologists. By gathering together this radio information the scientists can then make a map of the Atlantic Ocean, showing the directions of

prevailing winds and how often they change their direction. This information can be used in making more accurate weather forecasts for ships and aircraft.

This "egg" is made from a particular kind of material called polyester — a very hard plastic which is also used to make boats and sports car bodies.

THE BALL YOU CAN'T LOSE

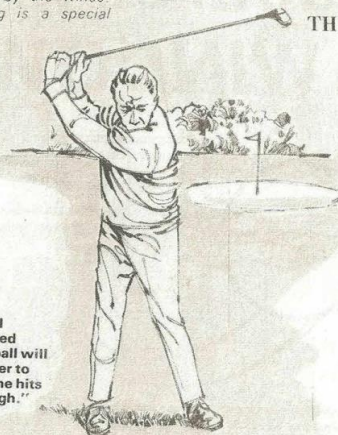
This very "ordinary" looking golf ball is about to be driven off the tee by the man with the club. Normally, if the man is not a good player, he might well be spending the next hour hunting for the ball! Not this ball, however.

For it contains a battery and a tiny radio transmitter. The moment the ball is struck by the club, the radio transmitter starts broadcasting a signal.

To find a ball lost in the bushes or a grove of trees all the player has to do is "tune in" to the ball with a transistor radio. He will hear a high-pitched whistle. By turning the radio until the whistle is at its loudest he can "sight" along the edge of the radio to find the direction from which the signal is coming. This will give him the direction in which he must start walking.

And the closer he comes to the ball, the louder the signal will get.

Right: The small transmitter buried inside the golf ball will enable this golfer to trace the ball if he hits it into the "rough."



LOOK LEARN

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No. 542, 3rd June, 1972

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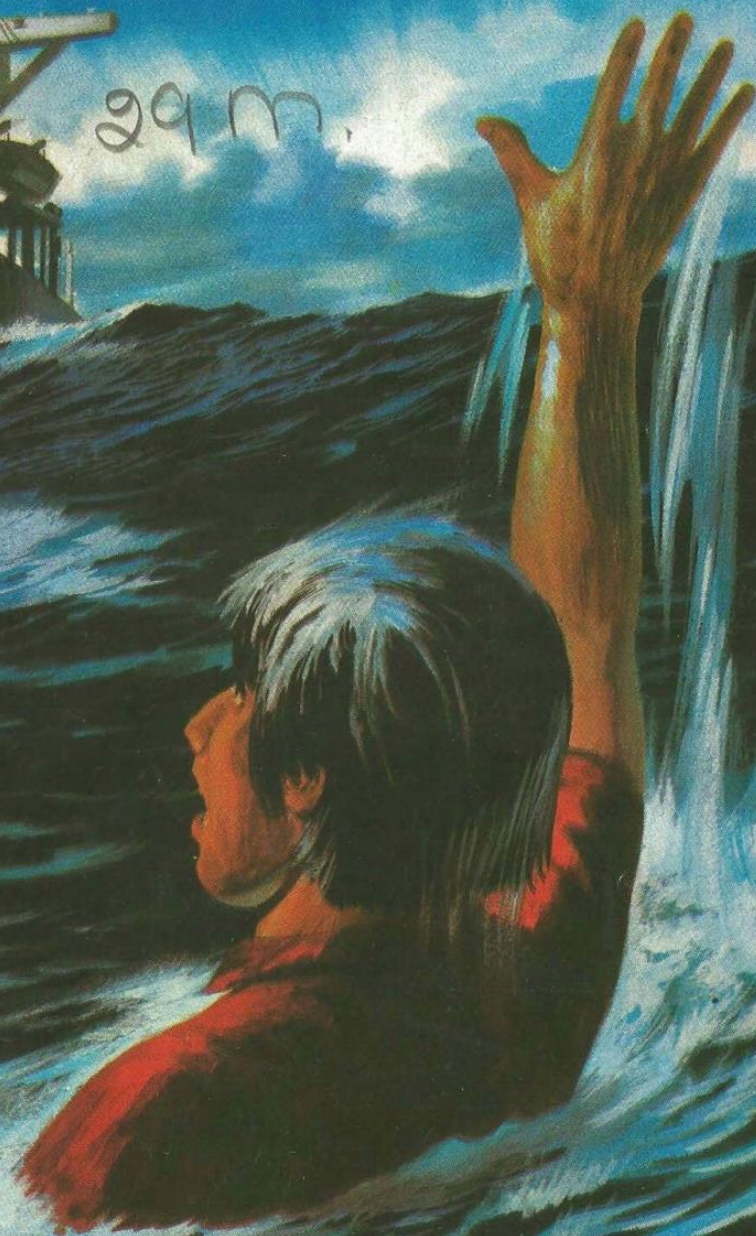


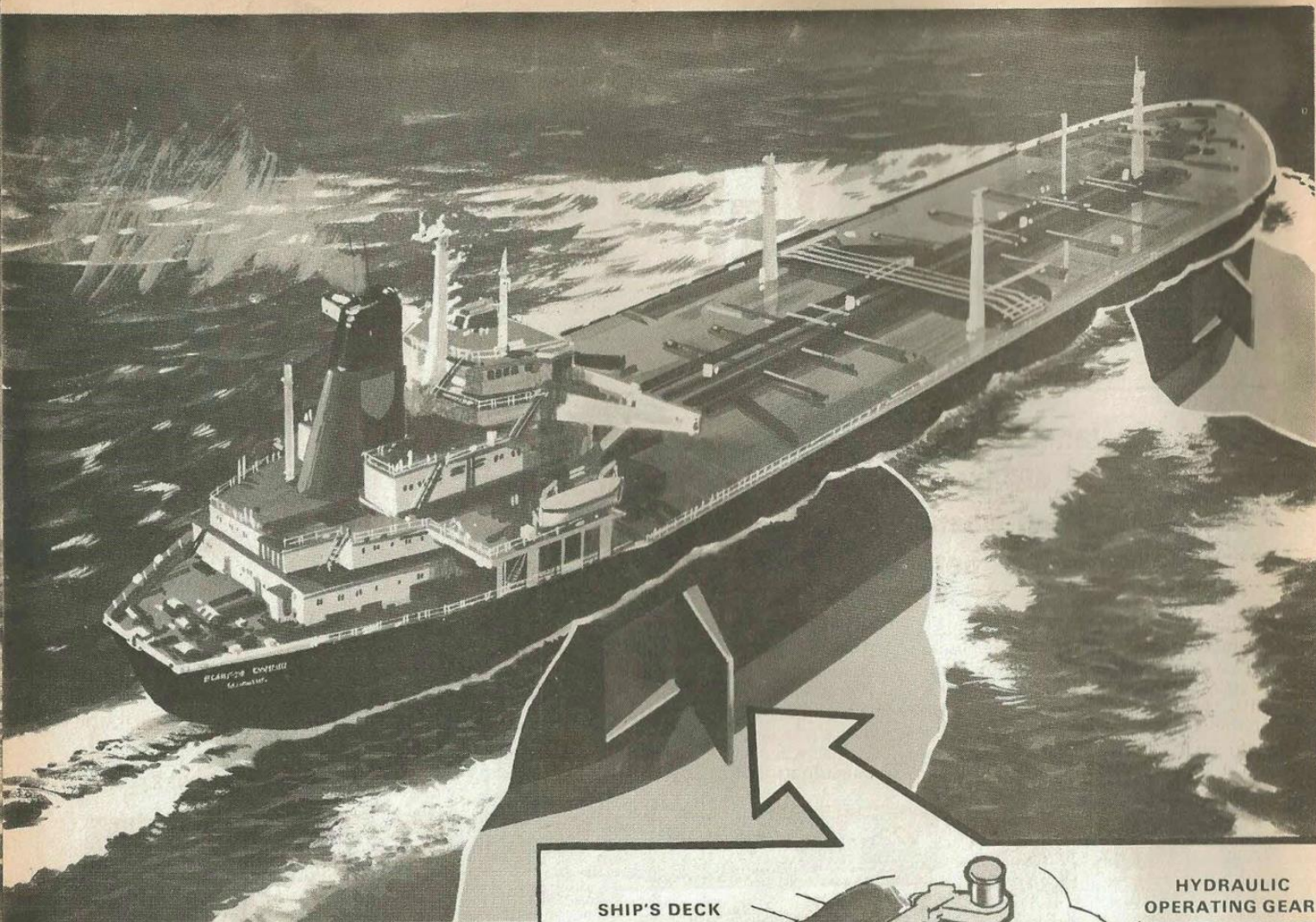
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A SPEEDING
SUPERTANKER
AND THE
CHANCES OF A

...MAN
OVERBOARD

SEE INSIDE





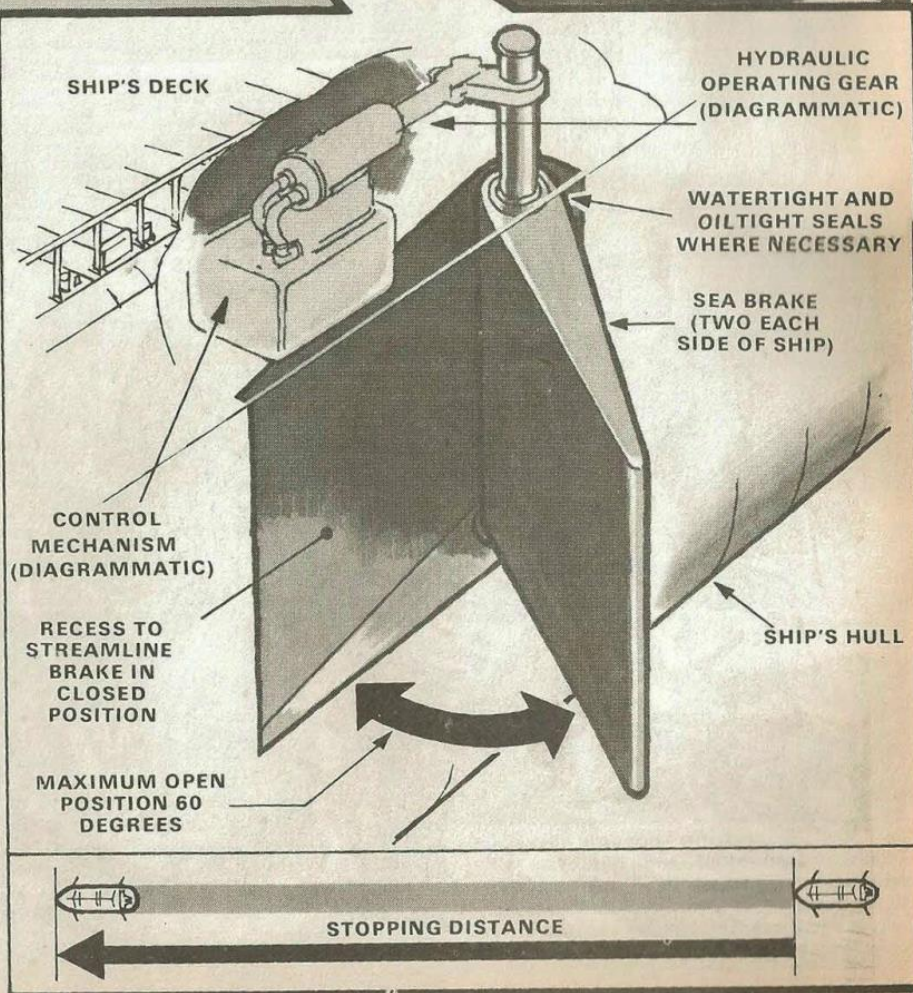
SLAMMING ON THE "BRAKES"—AT SEA

This diagram shows how the "sea brake" could be fitted to a large ship. Tests with models have shown that four large hydraulically-operated vanes, two at the bow and two at the stern, could stop a ship weighing 160,000 tons in $8\frac{1}{2}$ times its own length or about $1\frac{1}{4}$ miles.

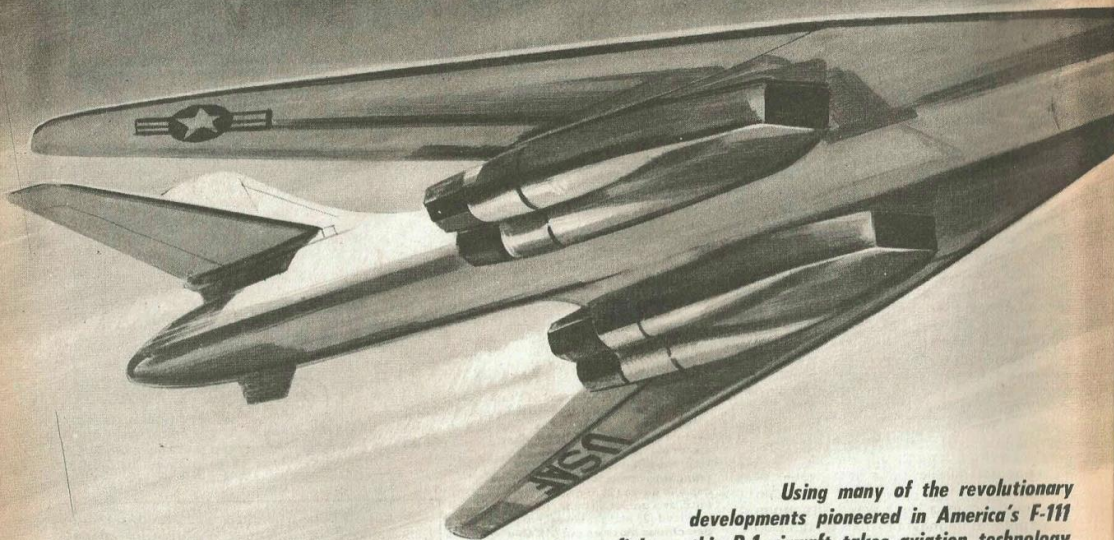
undergoing successful tests using model ships in special test tanks.

Named the Griffiths Sea Brake the device consists of four hydraulically-operated flaps, two port and starboard, well forward in the ship's parallel hull, and two well aft, recessed into the hull to avoid interference with the flow of water past the ship.

Tests have been conducted to find out the size of the flaps needed to stop ships of 160,000 tons and 250,000 tons. Results have shown that the smaller vessel could be brought to rest in $8\frac{1}{2}$ ship lengths, using flaps with a total area of 2,000 square feet (i.e. each flap measuring 20 feet by 25 feet). Exactly double the area is needed to stop the larger ship. Both tests discounted the effect of using the braking effort of the ship's propeller when ordered "Full astern."



On Wings That Swing



Using many of the revolutionary developments pioneered in America's F-111 fighter, this B-1 aircraft takes aviation technology well into the future—at a staggering cost

SWING wings and an enclosed escape capsule — these are among the many exciting new developments that are being built into America's latest military aircraft, designed to succeed the aging B-52 bombers now in service with the United States Air Force.

Both these important developments have been pioneered in the F-111 fighter aircraft, and despite the problems experienced with the swing wing design, American experts now feel confident that they can use the system in an aircraft that is much larger than the F-111.

With the wings fully forward, the B-1 will have a span of 137 feet, giving it greater lift and enabling the aircraft to take off in about half the distance needed by a B-52 while carrying double the payload, about 60 tons. With the wings half-way back the B-1 will cruise more efficiently at subsonic speeds and with the wings swept all the way back, when the span will be only 78 feet, the aircraft will have a speed in the region of 1,800 mph.

In addition to the swing wings, the B-1 has at least two other unusual features. In an emergency the crew of four will be ejected from the stricken aircraft in a single escape capsule, in effect the complete cockpit of the aircraft. If the ejection is at high speed and high altitude, a drogue parachute will deploy to stabilise the capsule and slow it down. The capsule

itself is designed to glide rather than float down to the ground. At an acceptable altitude and speed the drogue will be released and the three main parachutes will blossom out. Beneath the capsule are rubber bags which will inflate automatically. Plugs in the bags will blow out when the capsule touches the ground and the controlled flow of escaping gas will soften the shock of landing. If the capsule should land in water other gas-filled bags will keep it upright and afloat. For ejection at low-altitude the capsule is fitted with a small rocket motor that will power it up to a safe height for the main parachutes to be released.

HEDGE-HOPPER

A similar system is fitted to the F-111 and has been used successfully for emergency escapes. Explosive charges are used to cut all control cables and connections which join the cockpit to the main fuselage, and even to tighten the pilot's safety harness so he is kept firmly in his seat.

The B-1 is designed both for high altitude flying, and for very low altitude operation so it can "hedge-hop" under an enemy's radar defences. Flying as low as 400 feet at near supersonic speed is beyond the capabilities of even the most

experienced pilot, so the B-1 uses computerised terrain-following radar for the job. This automatically follows the contours of the ground and lifts the aircraft over hills and mountains, making adjustments to the aircraft's height and course. To smooth out the ride at low altitude, where fast-flying aircraft really get knocked around, designers have placed canards, or vanes, near the needle-nose section of the B-1. The effects of air turbulence on the crews flying at low altitude can be compared to driving a car very quickly over a road with a wavy surface, but the vanes, controlled by a computer, damp out this up-and-down effect, making it easier for the crew to concentrate on flying.

The B-1 will take-off with its wings spread wide and then trim them back for cruising. At cruising altitude, normally 50,000 feet, it will be refuelled by a tanker aircraft. This is necessary because today's big jets use up such tremendous amounts of fuel in take-off. Once the tanks have been topped up the B-1 should have a range of about 10,000 miles.

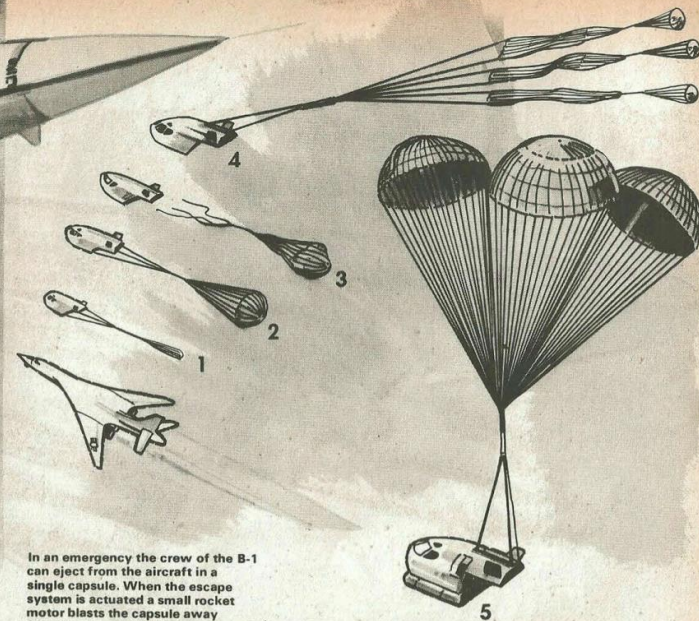
But whether the B-1 will take to the air at all is a big question mark at the moment. The aircraft has already caught a lot of flak — of the American Congressional variety. The United States lawmakers contend that the aircraft is not really necessary in these days of inter-

continental missiles, and is a waste of money at a time when the American economy is in a bad way. The huge amounts of money needed to develop and launch a project such as this are staggering. The Department of Defence have ordered cut-backs in the B-1 programme, but even this "economy" means that to get one B-1 prototype flying will cost over one billion dollars!

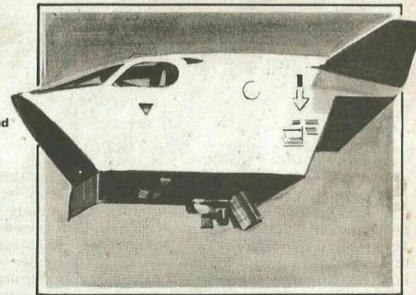
Even so, North American Rockwell, the builders of the B-1, recently unveiled a full size mock-up of the aircraft at its Los Angeles factory. Present plans allow the company to build three B-1s for flight tests and a fuselage for metal fatigue tests. The first flight for the aircraft will take place in 1974 and if all goes well it might be in service with the USAF by 1978.

THIS IS THE B-1

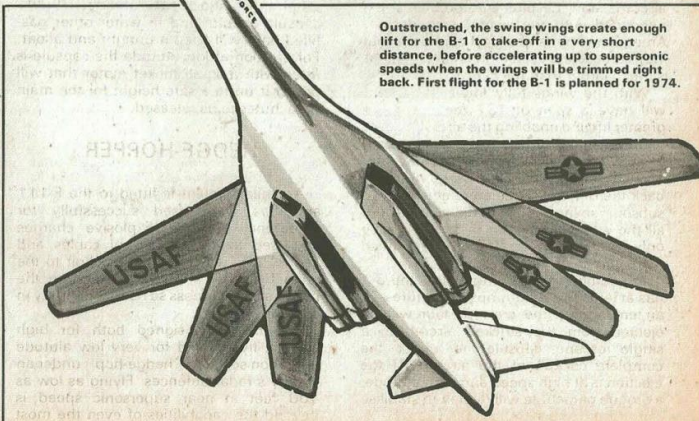
Wingspan: forward-137 feet; swept back-78 feet.
Length: 143.3 feet.
Height: 33.6 feet.
Maximum speed: 1,700-1,800 mph.
Range: Intercontinental-10,000 miles.
Engines: four able to produce 120,000 lb thrust.
Weight: 156-178 tons.
Crew: Pilot, co-pilot, two systems-operators.



In an emergency the crew of the B-1 can eject from the aircraft in a single capsule. When the escape system is actuated a small rocket motor blasts the capsule away from the aircraft (1). A drogue parachute opens to slow the capsule down (2) and stabilise it until, at a preset altitude, this is released (3) and the three main parachutes blossom out (4). Gas bags beneath the capsule automatically inflate (5) and when the capsule touches down plugs in their sides blow out, giving a controlled deflation that cushions the landing. If the capsule should land in the sea other gas-filled bags keep the capsule upright and afloat.



Vanes help the capsule to glide as well as float down.



Outstretched, the swing wings create enough lift for the B-1 to take-off in a very short distance, before accelerating up to supersonic speeds when the wings will be trimmed right back. First flight for the B-1 is planned for 1974.

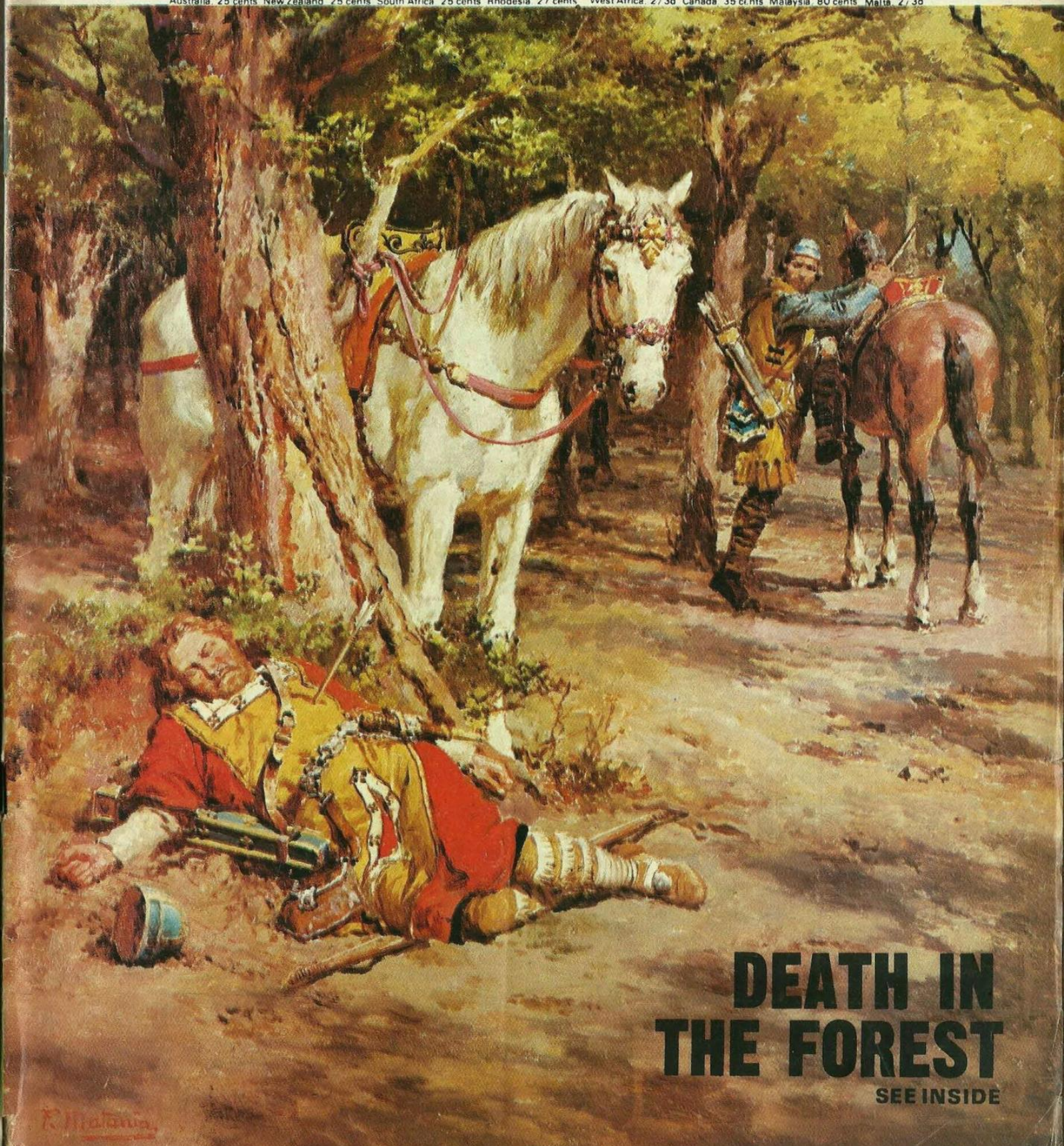
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DEATH IN THE FOREST

SEE INSIDE

R. H. H. H.



Helping to pave the way for a new generation of aircraft that will take-off and land vertically, this German VAK-191B makes use of not one but three jet engines to give it that extra "get-up and go!"

Jumping Jets!

THE virtues of an aircraft which can take-off and land vertically have been recognised by military and commercial air specialists for a long time. These aircraft can operate from hastily prepared clearings in jungles or forests, from the flat roofs of large buildings and from small platforms on almost any type of ship, yet they are capable of flying at high speed and delivering a formidable blow to an enemy in terms of firepower.

Britain's Hawker Siddeley Harrier was one of the first military Vertical/Short Take-off and Landing (V/Stol) aircraft to go into operational service, making use of this flight principle very successfully. Now Germany, in collaboration with Italy, has produced its first V/Stol aircraft — the VAK-191B.

Unlike the Harrier, which has one main engine with swivelling or vectored exhausts that turn during the transition from upward to forward flight, the VAK-191B makes use of three engines. The main engine in the middle of the fuselage provides normal flight power as well as

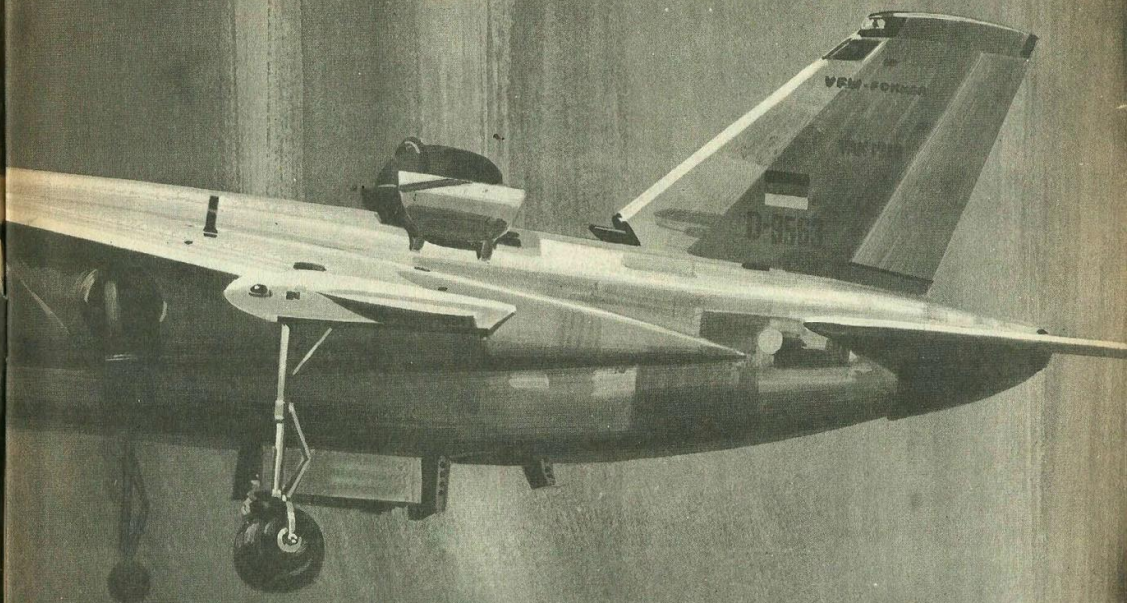
about 50 per cent of the lift needed for vertical take-off. The other half of the power for take-off only is provided by two smaller lift engines mounted fore and aft. These are mounted about 12½ degrees to the vertical so should the main engine be damaged during a mission, the slight amount of forward propulsion they provide could be used as a "get-you-home" measure by the pilot.

Once the VAK-191B is airborne and in normal forward flight the two lift engines are "shut down" and only the lift/cruise engine is used, giving the aircraft much better fuel economy than the Harrier.

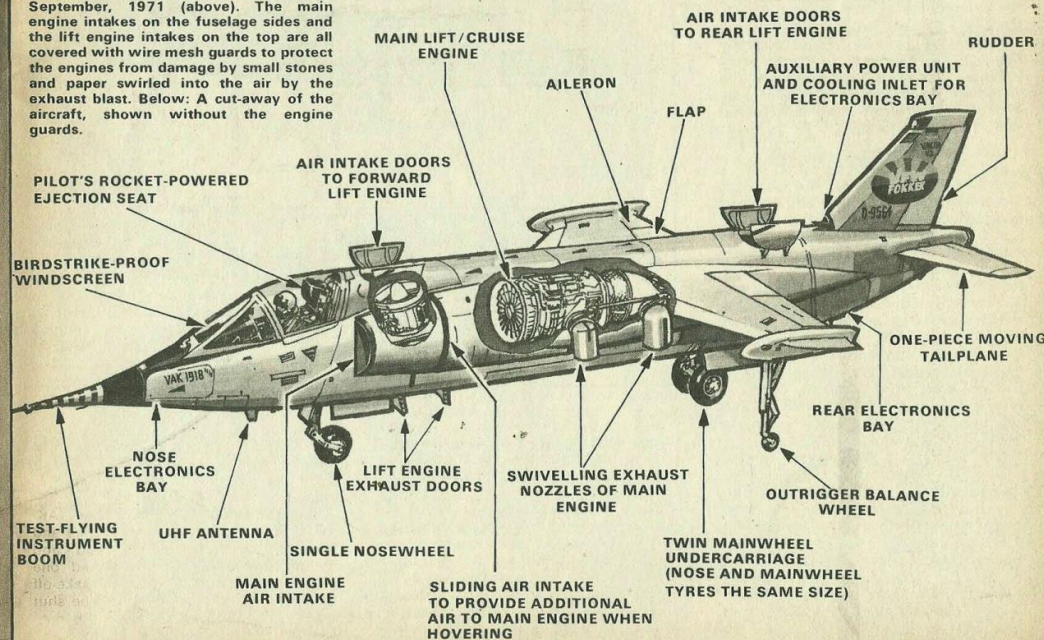
Both the small lift engines in the VAK-191B are controlled by one throttle and their performance is monitored and compared continuously so should one engine lose power in the crucial take-off or landing period, the other will be shut down immediately to prevent a dangerous imbalance of thrust.

To manoeuvre, an aircraft needs an

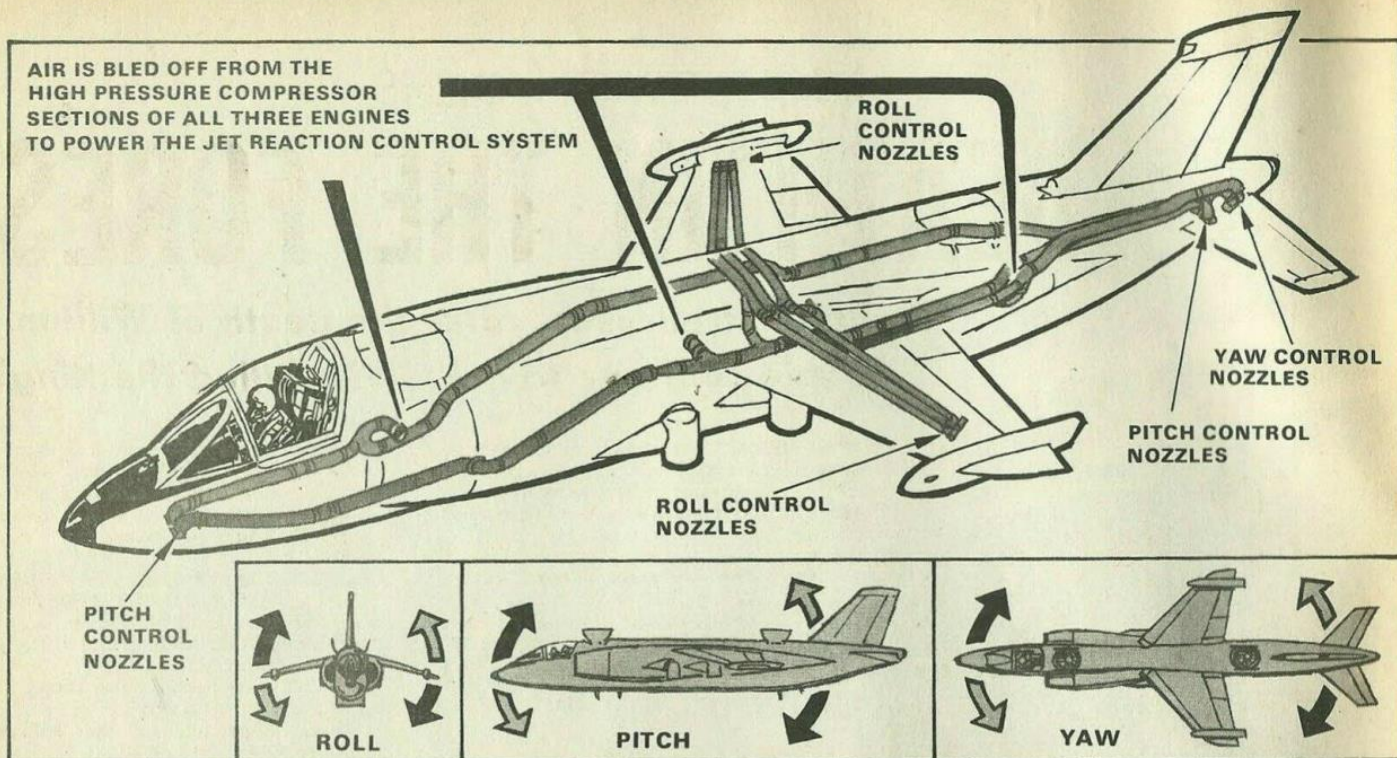
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The VAK-191B flew for the first time in September, 1971 (above). The main engine intakes on the fuselage sides and the lift engine intakes on the top are all covered with wire mesh guards to protect the engines from damage by small stones and paper swirled into the air by the exhaust blast. Below: A cut-away of the aircraft, shown without the engine guards.



AIR IS BLED OFF FROM THE HIGH PRESSURE COMPRESSOR SECTIONS OF ALL THREE ENGINES TO POWER THE JET REACTION CONTROL SYSTEM



airflow over the control surfaces of its wings and tailplane but when a V/STOL aircraft takes-off or lands this airflow is non-existent. To counteract this the aircraft is fitted with a jet reaction control system which bleeds off high pressure air from all three engines and ducts it to nozzles in the wing tips, tail and nose of the aircraft. The system is controlled by the pilot's stick and rudder controls which "puffs" out air to a greater or lesser degree from the nozzles, thereby controlling the roll, pitch and yaw of the aircraft and keeping it steady until enough forward speed has been achieved to fly the aircraft normally.

FLYING BY WIRE

A mission in the VAK-191B, which is designed for bombing, reconnaissance and ground attack, would begin with the starting of the main lift/cruise engine. During ground running the forward section of each lift/cruise engine intake is slid forward about 10 inches making a slot through which some 70 per cent of the air needed for the main engine flows. Ducts in the top and bottom of the fuselage are then opened and the fore and aft lift engines are started. Once the aircraft has taken-off and moved into horizontal flight, the two lift engines are stopped and the ducts closed.

The aircraft controls are worked electrically, movements on the control column and the rudder pedals sending electric signals to the power units that control the wings and rudder. In the event of a total electrical failure there is also a mechanical system to fly the aircraft.

Once the aircraft has performed its mission it returns to base and before landing the pilot opens the upper and lower fuselage ducts. Air flowing past the lower lift engine ducts creates a low pressure area, inducing a flow of air

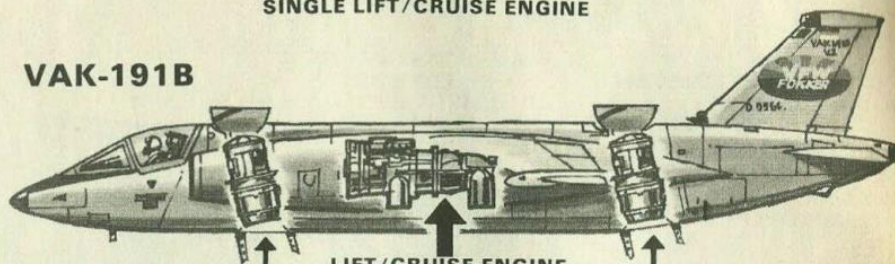
Above: For control in flight an aircraft needs airflow over its wings and tail. When a V/STOL aircraft is going up or down no airflow exists, so a "puff-jet" reaction control system operates through the pilot's control column and rudder pedals, blowing high pressure air from the wing tips, tail and nose to keep the aircraft stable. Below: Comparison between the power units of Britain's Harrier "jump-jet" and the German VAK-191B.

HAWKER-SIDDELEY HARRIER



SINGLE LIFT/CRUISE ENGINE

VAK-191B



LIFT/CRUISE ENGINE

TWO LIFT ENGINES

through the upper doors that spins the turbine blades of the lift engines and starts them up in time for the vertical landing.

The VAK-191B flew for the first time in September, 1971, ten years after the first design studies had been made. If this seems a long time for an aircraft to "take-off from the drawing board" it must be remembered that many problems had to be overcome in this untried system of take-off and landing. Originally the aircraft was to play a major role in NATO's plan for the defence of Europe, but over

the years the role of "limited mission" planes has been replaced with a desire to have a "Multi-Role Combat Aircraft" (MRCA) — a general purpose aircraft that can carry out all the military roles required for defence.

It now looks as though the VAK-191B will not go into operational service. Instead it might become a flying "test-bed" for the next "generation" of V/STOL "swing-wing" aircraft and will provide much valuable information for future "jump-jet" programmes, both commercial and military.

MYSTERIES OF THE SEA

Saga of a Sea-Serpent

Was there really a mysterious monster terrorising the world's oceans? Mariners who claimed to have seen it, said it had a long, serpentine body, a series of humps and the head of a horse.

THE sea was calm on that day in the June of 1808, when Mr. Maclean, the parish minister of the island of Eigg, took some of his parishioners for a row off the west coast of Scotland. Bent as he was over the oars, the good minister did not have a great deal of time to study the rugged coast which was being admired by his companions. He did, however, have time to notice what appeared to be a rock jutting out of the water, only a short distance away from his boat. Mr Maclean knew these waters well, and he was puzzled. He had never seen this particular rock before. Why then had it suddenly

sprouted from the waters almost overnight?

It was at this point that an object reared itself out of the water, and Mr Maclean saw with horror that what he had taken to be a rock, was in fact an enormous sea serpent which was now making its way towards his boat. Fortunately, the minister and his companions were only a short distance from the shore, and he was able to reach it safely before the sea serpent could overtake them. Scrambling on to the beach, Mr Maclean looked briefly over his shoulder in time to catch sight of it lifting its monstrous head again before it disappeared under water.

Later, Mr Maclean gave a graphic description of his pursuer.

"Its head," he wrote, "was somewhat broad and its form somewhat oval; its neck rather smaller, its shoulders, if I can term them, considerably broader, and thence it tapered to a tail which it kept low in the water. It had no fins, as I could perceive, and seemed to me to move progressively by undulations up and down. I believed it to be between

seventy and eighty feet long."

One may wonder how a man rowing for his very life was able to assimilate all those details. Be that as it may, this was the first time that the sea serpent literally reared its head to the public.

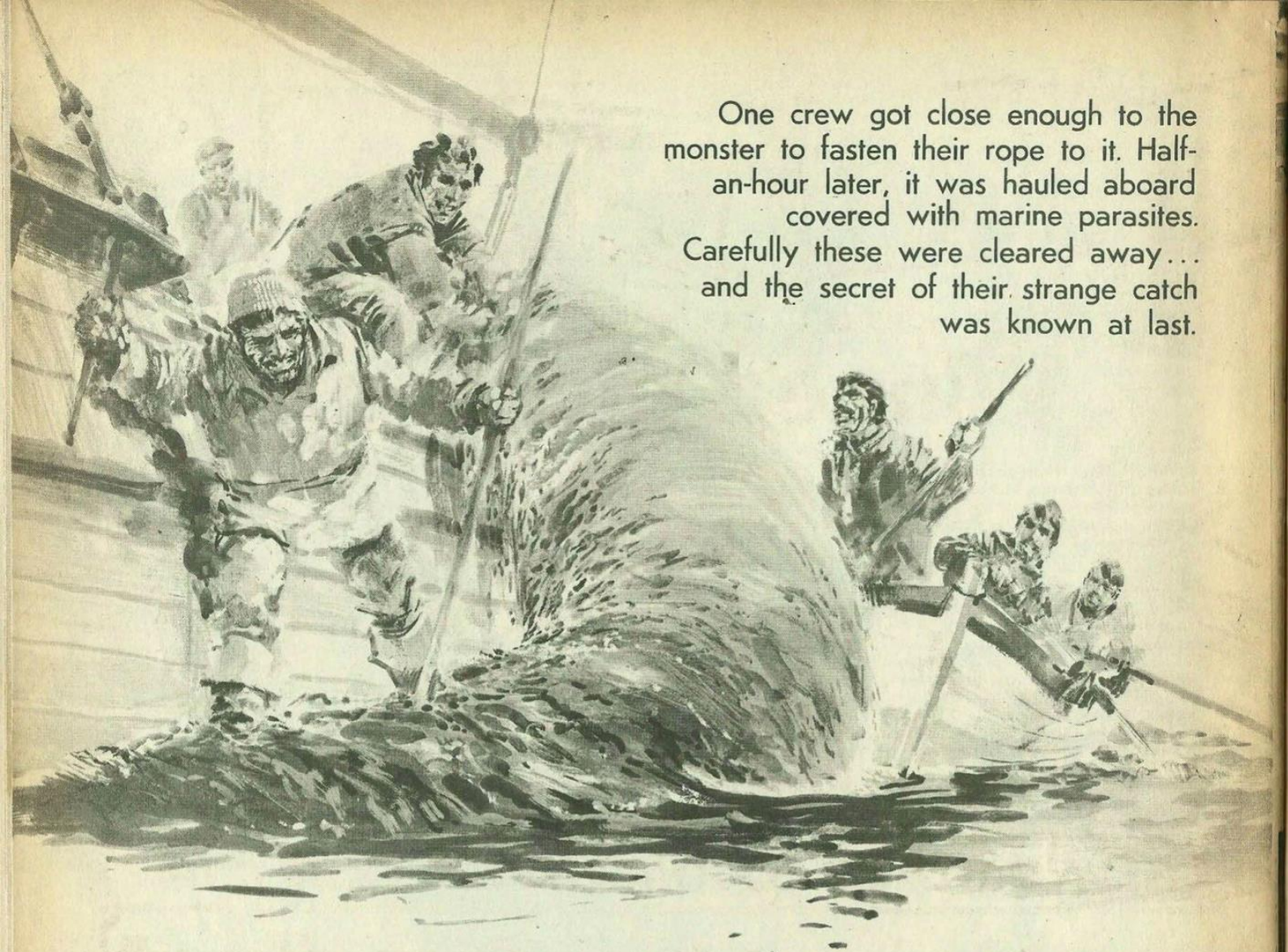
It may be wrong to say that the minister might have been exaggerating, for it has to be said that on that very same day the sea serpent was also seen by no less than the crews of thirteen fishing boats, who, like the minister, made for the shore as fast as they could.

The sea serpent must have taken a strong dislike to the waters of that part of the world, for the next we hear of its being seen, is on the other side of the Atlantic, where it

CONTINUED ON NEXT PAGE



One crew got close enough to the monster to fasten their rope to it. Half-an-hour later, it was hauled aboard covered with marine parasites. Carefully these were cleared away... and the secret of their strange catch was known at last.



appears to have scared the wits out of a number of the residents of Gloucester and Nahant in Massachusetts, U.S.A.

By then, it also seems to have changed its appearance. Now, according to a number of the reports, it was about a hundred feet long with a body which resembled a string of humps, each about the size of a barrel. Another observer, on the other hand, who claimed to have had a clear view of the creature, stated emphatically that it had thirteen humps on its back.

The reports as to the size and physical characteristics of the creature varied so much that one begins to wonder if most, if not all, the "sightings" stemmed mainly from the imagination. Indeed, a number of people who had claimed to have seen the sea serpent, later confessed that they had only been hoaxing their friends.

If one continues to take seriously the reports about the sea serpent, it would seem to have been blessed with a long life. In 1875, sixty

seven years after it was first seen, the sea serpent was reported to have been sighted by several people on a yacht named the "Princess." Moreover, they followed it for two hours, and eventually got so close to it that they were able to look down its mouth.

Later than that even, in the year 1905, to be exact, it was seen off the coast of Brazil by two members of the Zoological Society. By then, according to their report, it had shrunk to a length of six feet, with the thickness of a man's body.

After all these contradictory reports, can one really believe that the sea serpent ever existed? It would seem not, though most of the witnesses had agreed on certain things. It had a long serpentine body, and it had a series of humps and a head rather like that of a horse.

What then did all these people see?

For one possible explanation let us turn to a report by a Captain Smith of the "Peking," which was

sailing near the African coast in the December of 1848. Standing on the bridge with a fellow officer he suddenly became aware of a strange object floating in the waters close to his vessel.

"With our telescope," he reported later, "we could from the 'Peking' perfectly distinguish an enormous head and a neck covered with a mane. This appearance was likewise seen by all our crew and everybody agreed that it must be a great sea serpent..."

With so many witnesses present together who were all in such accord, it would appear that they had indeed seen a sea monster of some sort.

But did they?

Let us examine the rest of Captain Smith's report.

"I immediately ordered a boat to be lowered with an officer and four men aboard, furnished with some arms and a few fathoms of rope..."

Captain Smith's report goes on to tell how the intrepid crew of the boat got close enough to the "monster" to fasten their

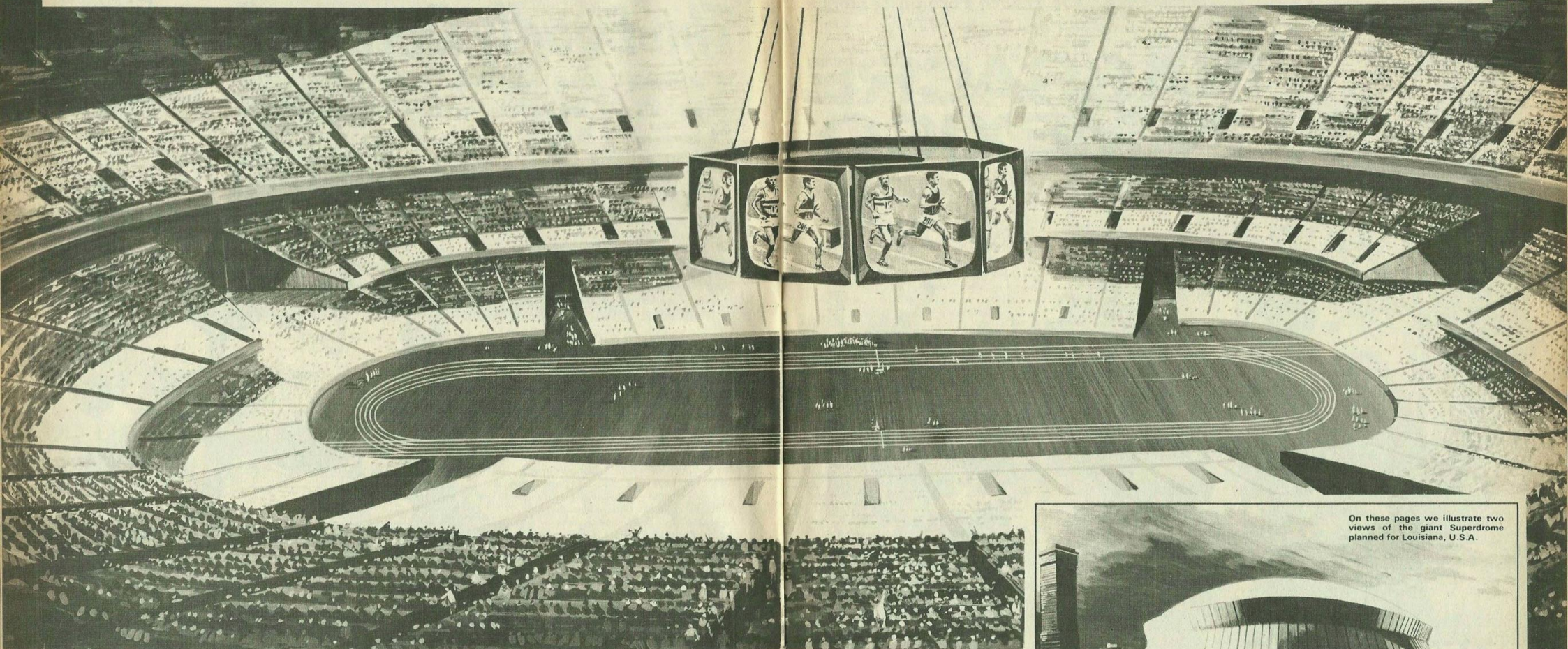
rope to it. Half an hour later, it was hauled aboard, when it was discovered to be covered with so many marine parasites that it was difficult to find out exactly what they had brought out of the sea. Eventually it was discovered that their catch was nothing more than an enormous piece of seaweed, more than a hundred feet long with a root to it which at a distance had looked like its head.

The last word belongs to Captain Smith. "If I had been unable to despatch the boat the moment I did so, I should have remained all my life with the conviction that I had seen the great serpent of the sea."

But does this really prove anything? Captain Smith's sea monster turned out to be nothing more than a monstrous piece of seaweed. But the Reverend Maclean who first saw the sea monster claims that he was actually chased by it, as were a number of other people. In the final summing up it is difficult to believe that all of them were lying to achieve a short lived notoriety.

THE SUPERSCREEN SUPERDOME

See sports stars in action and on television at the same time in a new Superdome in America



On these pages we illustrate two views of the giant Superdome planned for Louisiana, U.S.A.

GEORGIE BEST knows what it feels like to stand in the middle of a vast football stadium surrounded by thousands of cheering, shouting or booing spectators. The tensions must be terrific. But they may be even greater in a vast Superdome being built in New Orleans, Louisiana, U.S.A., which will have seats for 80,000 people.

Although Wembley, the mecca for all football fans in Britain, can hold 100,000 people under cover, with seats for 45,000 of them, the Superdome is going a step further.

The planners are going to suspend a huge three-sided colour television system over the centre playing field. Each screen will present pictures 39 feet wide by 33 feet high, so that the audience can have close-up pictures of the action.

Imagine Georgie Best boosted up to this

size. If the idea ever comes to Britain, you will be able to watch your mud-splashed favourites in every detail as they pause to shoot a vital goal.

Not only football, but athletics and other sports too will have the benefit of this treatment in Louisiana's Superdome, which is due to be finished in 1974.

When it is completed, it will rival the other great stadiums of the world, like the Strahov Stadium in Prague, Czechoslovakia where 240,000 spectators can see mass sports displays.

Rio de Janeiro in Brazil boasts the largest football stadium where 199,854 people saw the World Cup final between Brazil and Uruguay on 1st July, 1950. Here, a dry moat seven feet wide and five feet deep stops enthusiastic spectators from pouring on to the

pitch to show the players how to kick a ball. It also discourages any footballers who have not been trained in mountaineering from dashing into the crowd to silence those who boo or jeer vociferously.

Such behaviour is not tolerated in Britain, where the crowds content themselves with fighting each other, or wrecking the train on the way home.

INDOOR RAIN

If Wembley boasts the largest covered stadium (scene of the 1948 Olympic Games and the 1966 World Cup), the largest indoor stadium (according to the Guinness Book of Records) is the Harris County Sports Stadium in Houston, Texas, U.S.A.

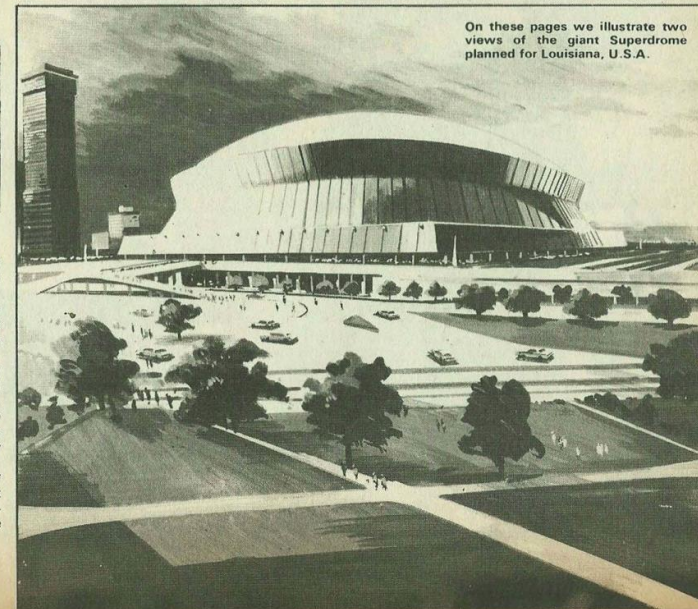
Called the Astrodome, it has a capacity of 45,000 for baseball and 66,000 for boxing.

So large is the domed stadium, which covers 9½ acres, that an 18 storey building could be built under the roof, which is 208 feet high.

The strange fact is that inside this building the humidity is such that it would rain in some conditions if the air cooling equipment were turned off.

Britain, however, is not to be outdone by these mammoth buildings. For sheer crowd capacity, not necessarily under a roof, Hamden Park, Glasgow, would be hard to beat. The crowd which can get in there to see a match totals 149,547 — enormous in any language.

But television close-ups of the players? For the moment that is being left to the giant screens in Louisiana. However, it is undoubtedly only a matter of time before the phenomenon reaches Britain.



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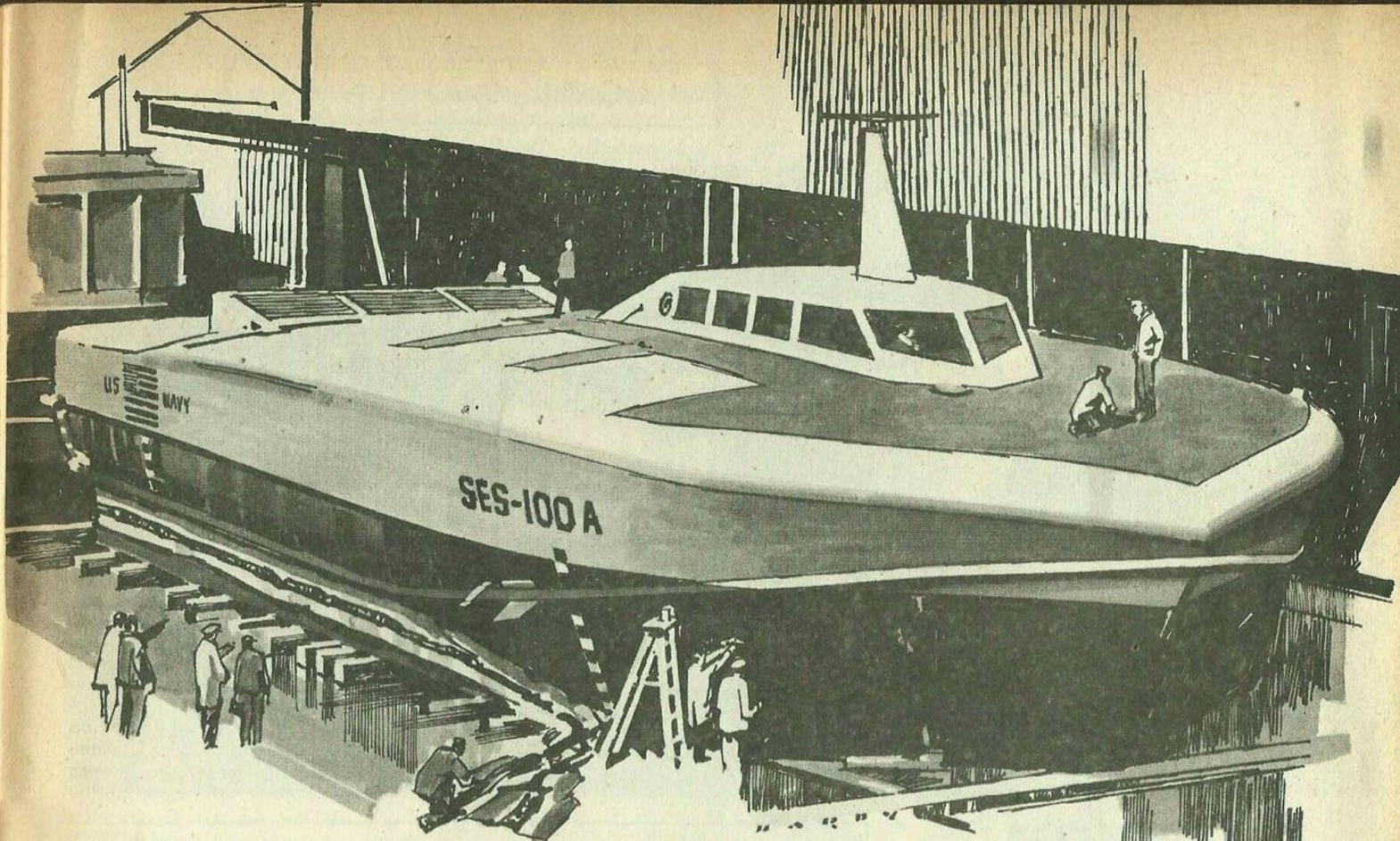
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THE 100 mph SUPER SHIPS

SEE INSIDE



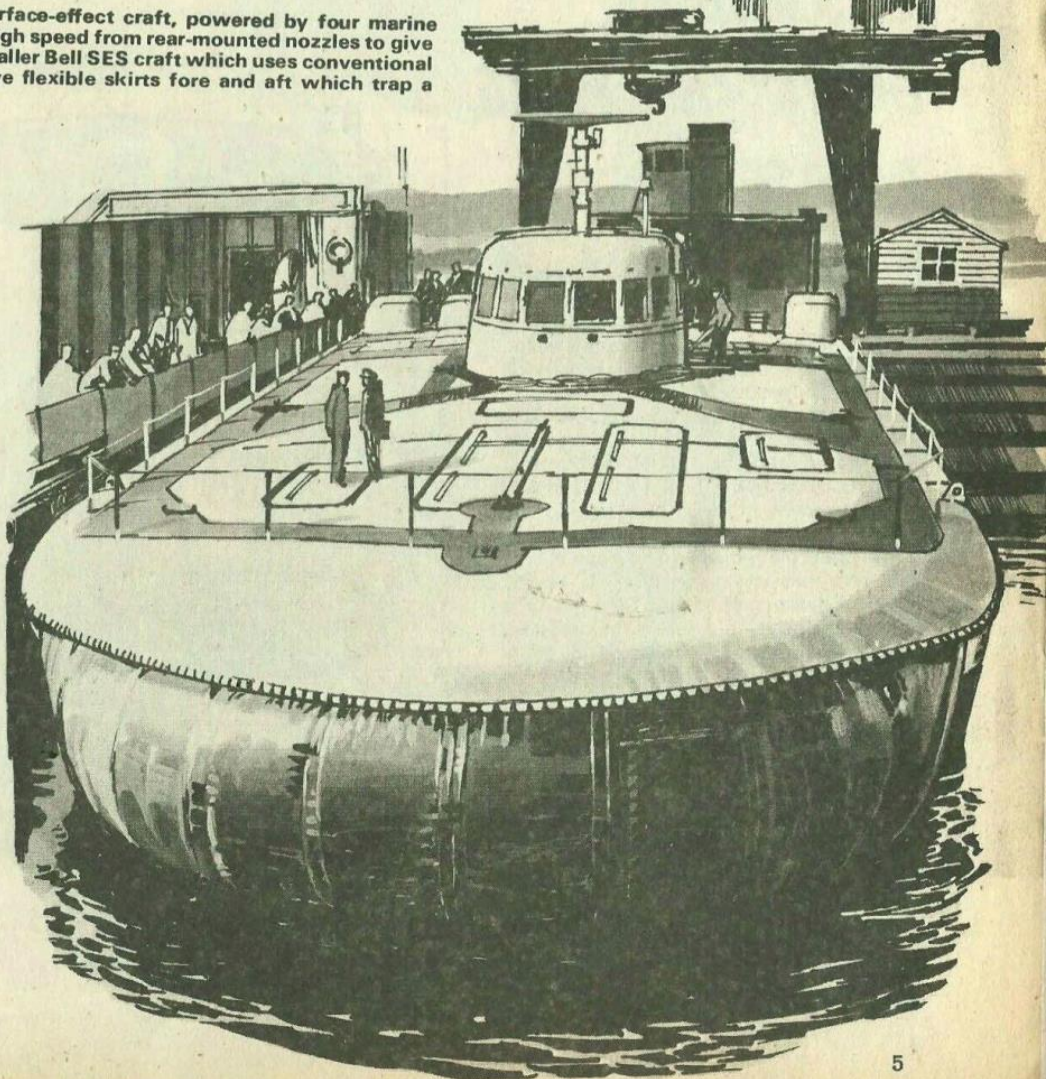
Above: the Aerojet-General version of a surface-effect craft, powered by four marine gas-turbine engines that "squirt" water at high speed from rear-mounted nozzles to give the vessel forward propulsion. Below: the smaller Bell SES craft which uses conventional gas-turbine-driven propellers. Both craft have flexible skirts fore and aft which trap a bubble of air and give the necessary lift.

gas-turbine engines which draw water in through inlets and shoot it out under pressure through a rear mounted nozzle to provide thrust. This eliminates the need for propellers. The same engines drive fans which create the air bubbles under the fore and aft skirts.

The design of the Bell SES is more conventional. It is powered by three 4,500 hp marine gas-turbines which drive two high-efficiency propellers, and also carries three smaller engines to create its air bubbles.

According to American Navy chiefs, the speed of these surface-effect craft, will give the service a major advance in the fast-ferrying of troops and supplies. They will also be extremely useful for anti-submarine duties, as recent technical advances in the shaping of underwater craft has given submarines a greater speed than conventional surface craft.

If the SES idea looks favourable after the US Navy trials, the next step will probably be the design and development of a 2,000 ton experimental ship. If that is successful, still larger sizes will be tried. Some experts even believe that the principle becomes more efficient as the size of the vessel increases, but at the moment surface-effect craft up to 10,000 tons only are visualised, when the use of nuclear power for SES will become favourable.



**MORE SCIENCE
ON NEXT PAGE**

Passengers and cargo carried inside giant, hollow wings instead of a fuselage — this is the idea behind an exciting new aircraft now being flight-tested in Germany



'PASS RIGHT DOWN THE WING, PLEASE'

The X-113 Aerofoil boat is the latest brainchild of the legendary Dr. Alexander Lippisch, a German aviation scientist.

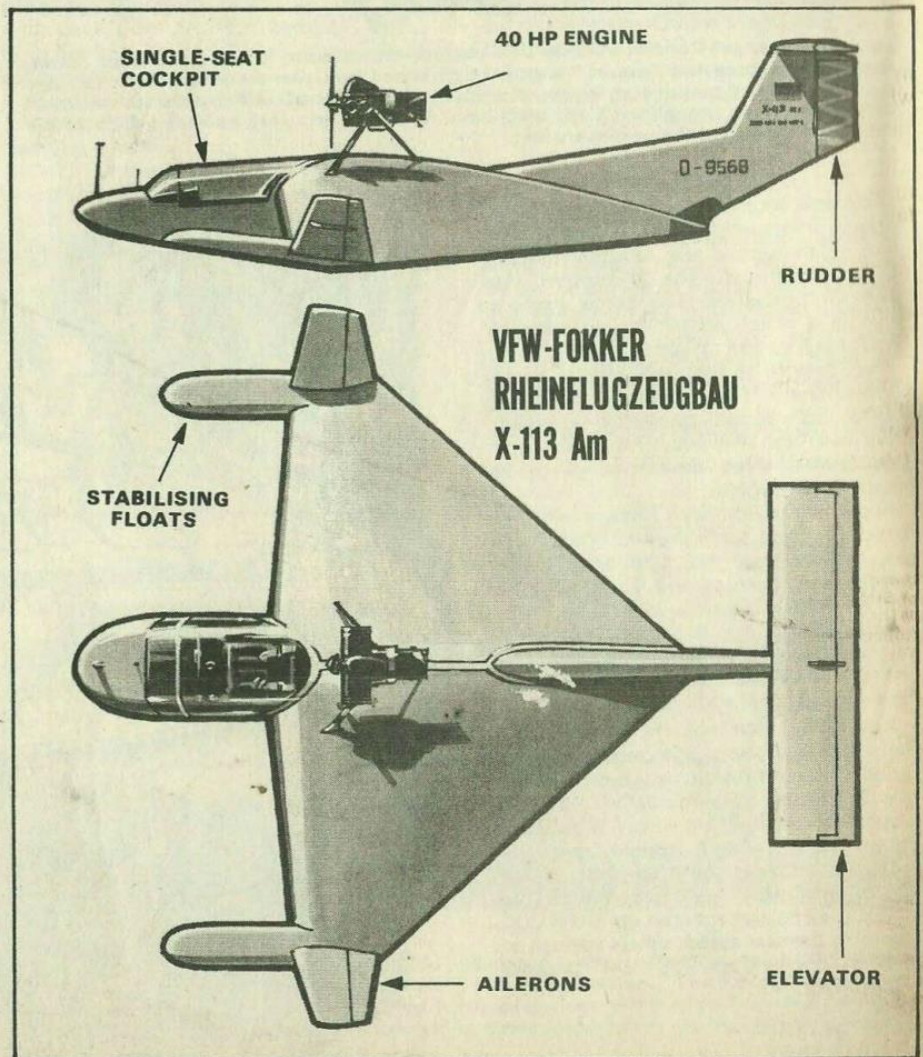
The aircraft is seen as a forerunner for coastal transportation particularly for under-developed countries.

Powered by a 40 hp engine, the prototype is 27 feet long with a wing span of 18.8 feet, and has a speed of 87 mph. Made from glass-fibre reinforced plastic, it weighs only 760 lbs and has so far flown 600 feet during its test programme.

The full-scale project would have a 160 feet wing span and a speed of 100 knots, carrying passengers and cargo in compartments built into its huge, hollow wings. It would, in effect, be a giant "flying cargo wing," built to operate at low altitudes.

Dr. Lippisch has been an aviation scientist and designer of radical and original ideas since well before the Second World War.

His early work on delta wing configuration and similar designs resulted in the tiny Messerschmitt Me. 163 "Komet" rocket-powered fighter which had a sensational, but short, career in the closing months of the Second World War as one of the most advanced weapons used to defend Germany against Allied bomber attacks.



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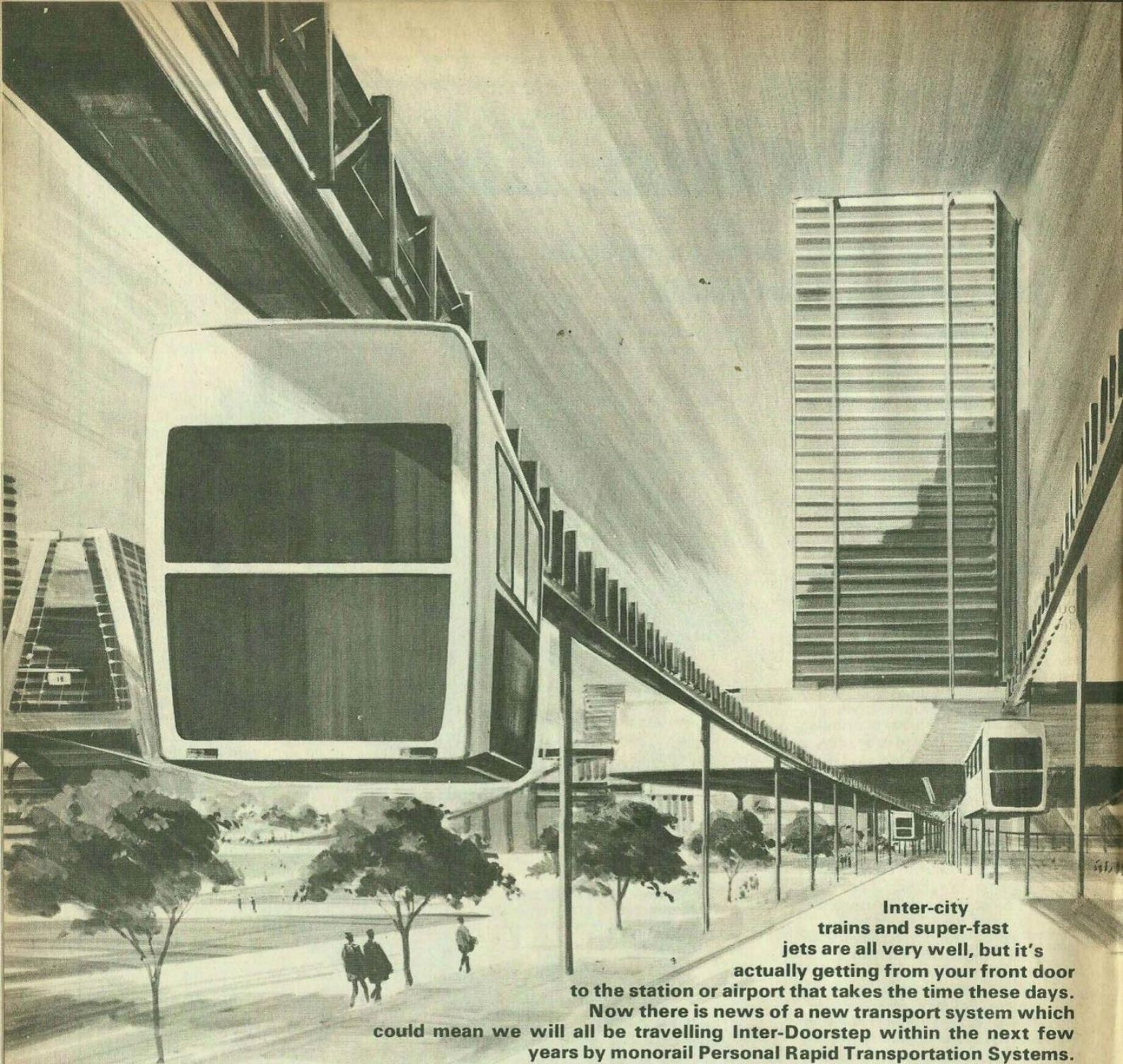
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BEGINS INSIDE

Folk Stories of America





**Inter-city
trains and super-fast
jets are all very well, but it's
actually getting from your front door
to the station or airport that takes the time these days.
Now there is news of a new transport system which
could mean we will all be travelling Inter-Doorstep within the next few
years by monorail Personal Rapid Transportation Systems.**

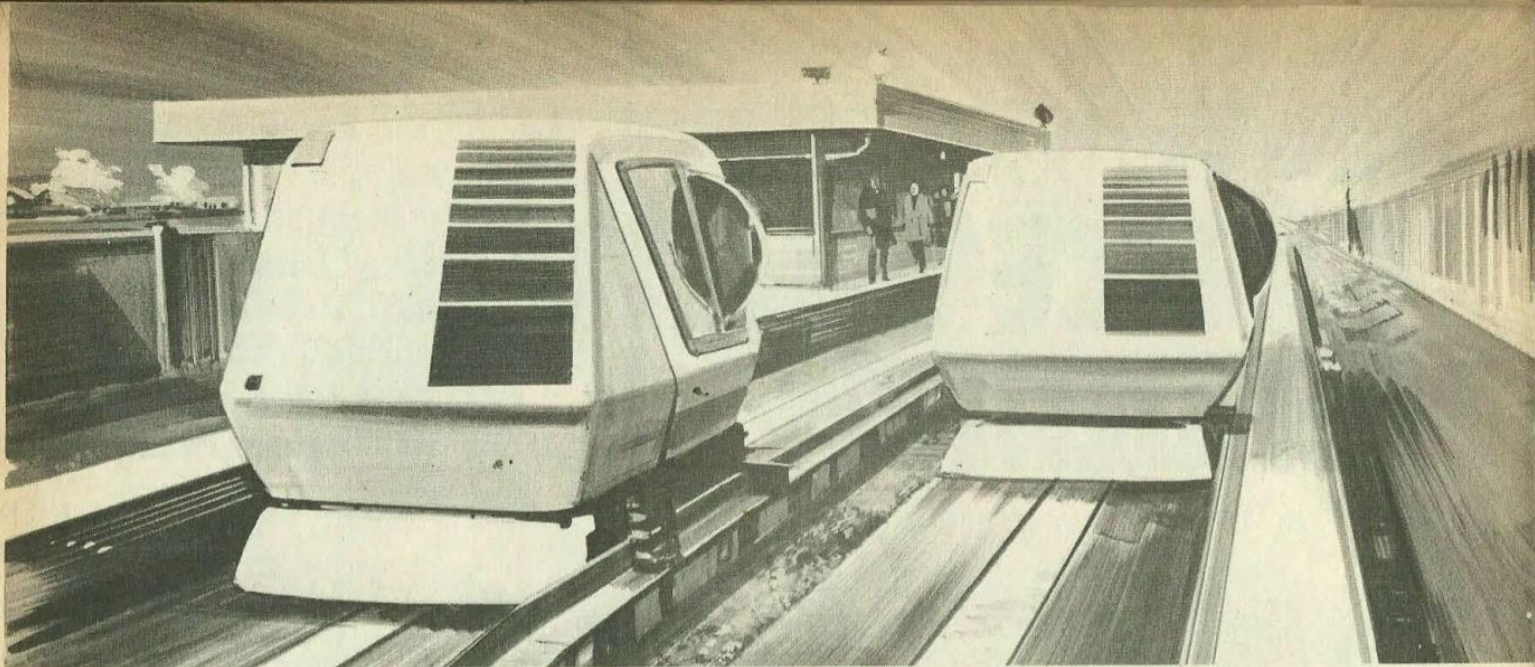
Inter-Doorstep —A New Way To Travel

If you go on a long trip you nearly always find that it is the last part of your journey which is the hardest. Getting from a station or the airport usually involves waiting for a bus, getting caught up in city traffic or long walks from the station or airport car park.

Now, from America, comes news of the Personal Rapid Transport System (PRT), designed to solve this problem of the final transportation straw that breaks the traveller's back.

The PRT is designed to provide fast, frequent services between closely-spaced stations, over a variety of routes during rush-hour periods, yet still provide an efficient service at night.

A cross between a lift and a monorail, PRT would take passengers almost directly to their destinations on elevated beams criss-crossing a city or leading out to suburban areas.



This PRT system uses cars supported on a cushion of air and driven along the elevated beam by linear-induction motors. It is designed for use in towns.

Minicars, ranging from four to 40 passenger versions which would operate under computer control on a guide rail, could skip stations not wanted by passengers and operate as closely together as one every six seconds. All the stations would be located off the main tracks, in sidings, so other cars could by-pass them. The cars will have no drivers and when they stop, often inside the foyers of large business buildings, the doors will open and close automatically.

During rush-hours the cars would be programmed to stop at particular stations. Indicator boards, like those used on London's Underground, would tell passengers the destination of each car. During off-peak periods the system would operate like a lift, in which passengers would press a button at the station to call a car and then press another button for their destination inside the car after boarding.

At Transpo '72, an international transportation exhibition being held at Dulles International Airport, four of these PRT systems have already been built to demonstrate their possibilities. Elsewhere in America two more permanent and

complex PRT systems are now under construction and should open late next year.

At Morgantown, West Virginia, a 3.2 mile track is being built to connect three teaching buildings belonging to a university. At present 1100 students have to travel from one building to the next by cars and buses, crowding on to a two-lane road and taking 70 minutes to cover the 1½ mile trip. The new PRT system should cut this time to less than 20 minutes.

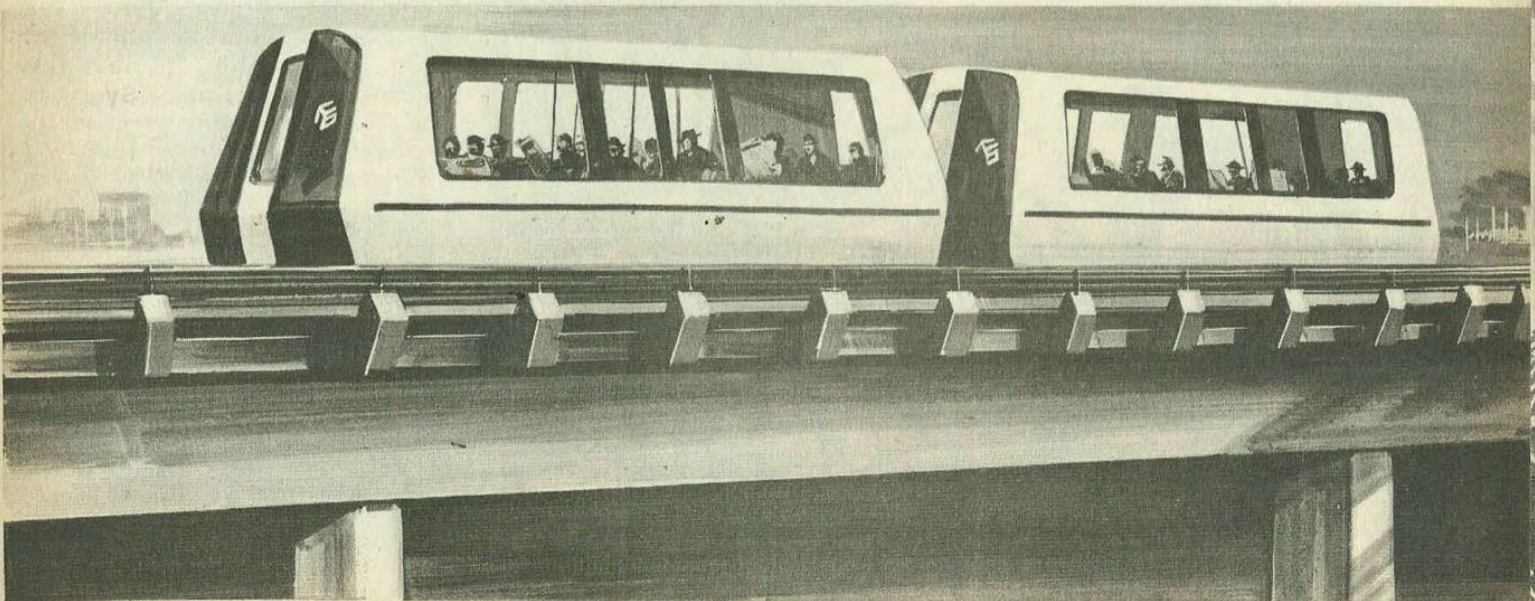
There will be six stations and 100 cars, each carrying 15 people at 30 mph and users will buy a season ticket costing 4p per day. This site will make an ideal testing ground for PRT as it has steep inclines, sharp curves, and must operate in a variety of weather conditions, including ice and snow.

The second system, being built at Dallas/Fort Worth Regional Airport, is a little different. The cars here will carry 40 passengers at 17 mph and will operate only on predetermined routes, so passengers will not be able to select their

destinations. The elevated rail will be 12 miles long and up to 9,000 passengers per hour will pay 10p to ride on the Airtrans. Average time for the trip, including waiting for a car, will be eight minutes.

Two of the four systems now being demonstrated at Transpo '72 use electric rubber-tyred minibuses. They are relatively quiet and non-polluting. Simpler operations of this type have already been built at airports and amusement parks, but unlike PRT these run an infrequent service, usually on just simple loop lines with no course changes or off-line stations. The two new working systems will show if present technology and "know-how" are readily available to control a complex PRT system by computer, to operate and switch cars running so close together and to keep the failure rate low.

If, as everyone expects, the American tests are successful, PRT's are likely to spring up all over the world within the next decade and may well be the system which finally evicts the motor car from our cities.



This is the Minitran, designed by Hawker-Siddeley of Britain. Each car carries 20 passengers.

LOOK LEARN

No. 551, 5th AUGUST 1972

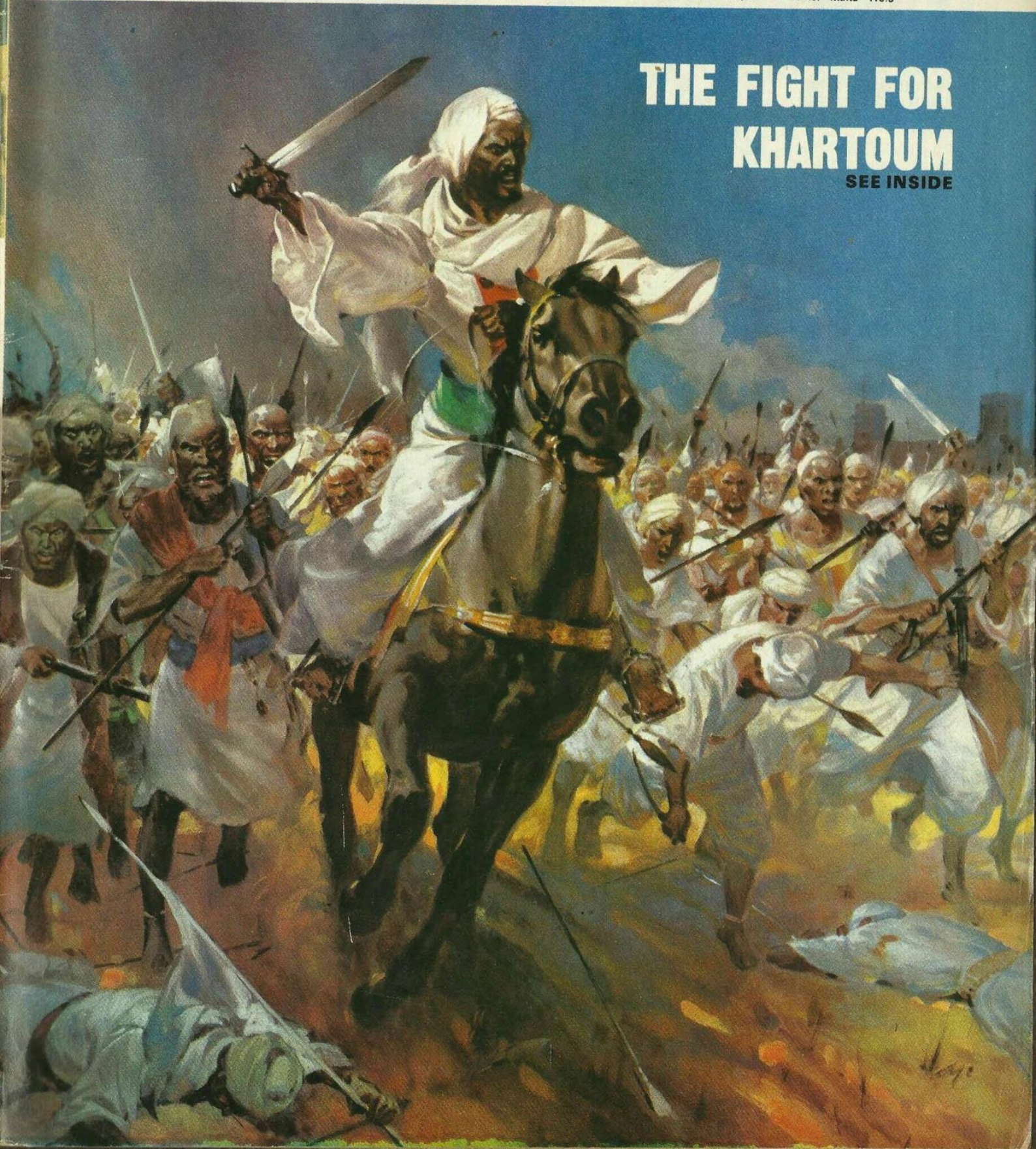
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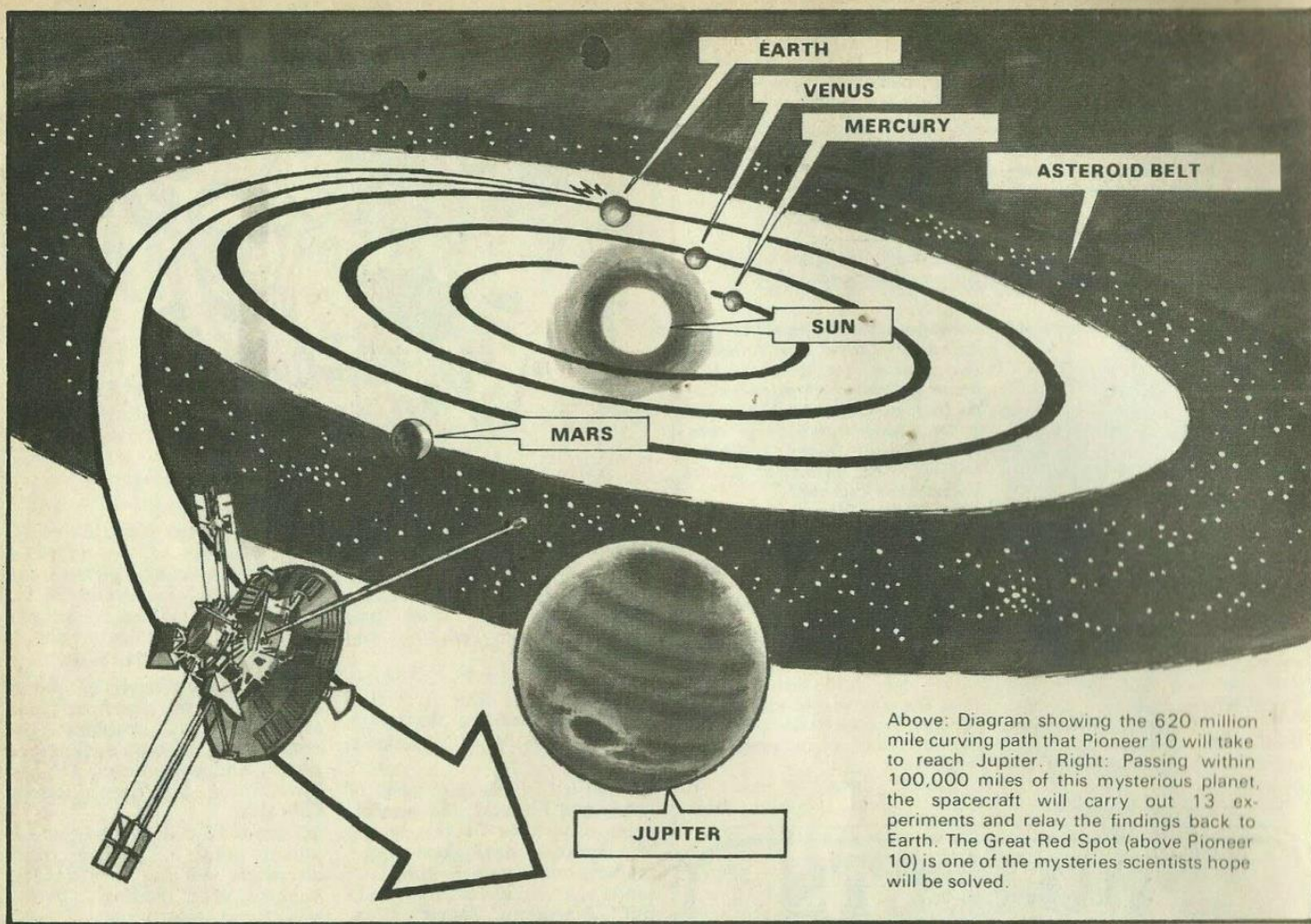
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THE FIGHT FOR KHARTOUM

SEE INSIDE





Above: Diagram showing the 620 million mile curving path that Pioneer 10 will take to reach Jupiter. Right: Passing within 100,000 miles of this mysterious planet, the spacecraft will carry out 13 experiments and relay the findings back to Earth. The Great Red Spot (above Pioneer 10) is one of the mysteries scientists hope will be solved.

LOOKING INTO SCIENCE

Across 500 million miles of space Pioneer 10 is speeding on its way to make a flying visit to Jupiter, the largest and perhaps the most mysterious planet in our solar system

JOURNEY TO MEET A GIANT

WITH a diameter of 86,000 miles, the planet Jupiter could contain 1,300 spheres the size of Earth. It rotates twice as fast as Earth and has twelve moons, three of which — Io, Ganymede and Callisto — are larger than our own moon. Earth-based studies have not yet established whether the giant planet is solid, liquid or gas for it is hidden from us by an atmosphere made up of hydrogen, methane and ammonia, forming dense layers of cloud in slate blue and salmon pink bands that encircle the planet.

So much we know, but by June, 1974 scientists hope to have learnt a good deal more about Jupiter, the largest and perhaps most mysterious planet in our solar system. It is hoped this new information will come from Pioneer 10(F),

an unmanned space research craft which was launched on 2nd March this year to undertake the longest and most difficult space probe to date.

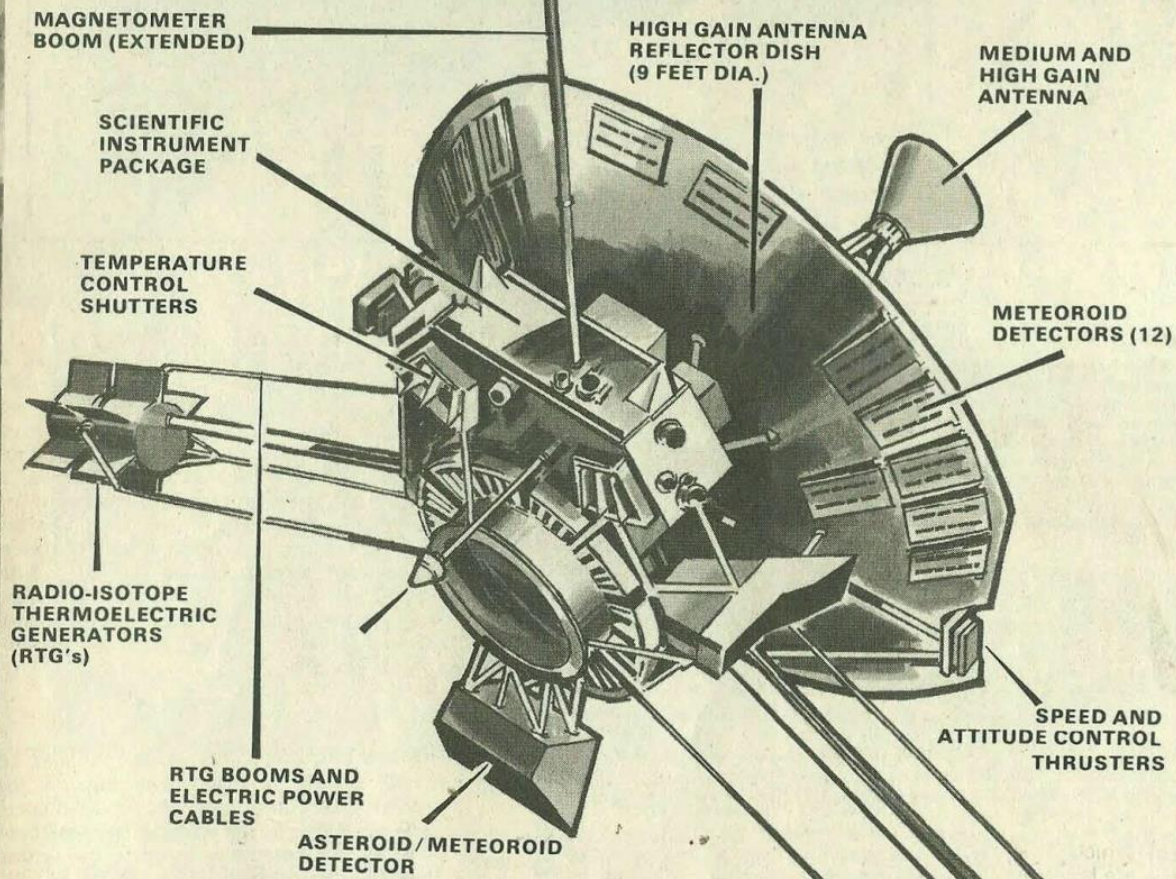
Pioneer 10 will be the first spacecraft to go outside our solar system on a journey of over 500 million miles, penetrating deep into galactic space and beyond. At a speed of 78,000 mph it will pass by Jupiter at a height of 100,000 miles, carrying out scientific experiments and relaying the information back to Earth.

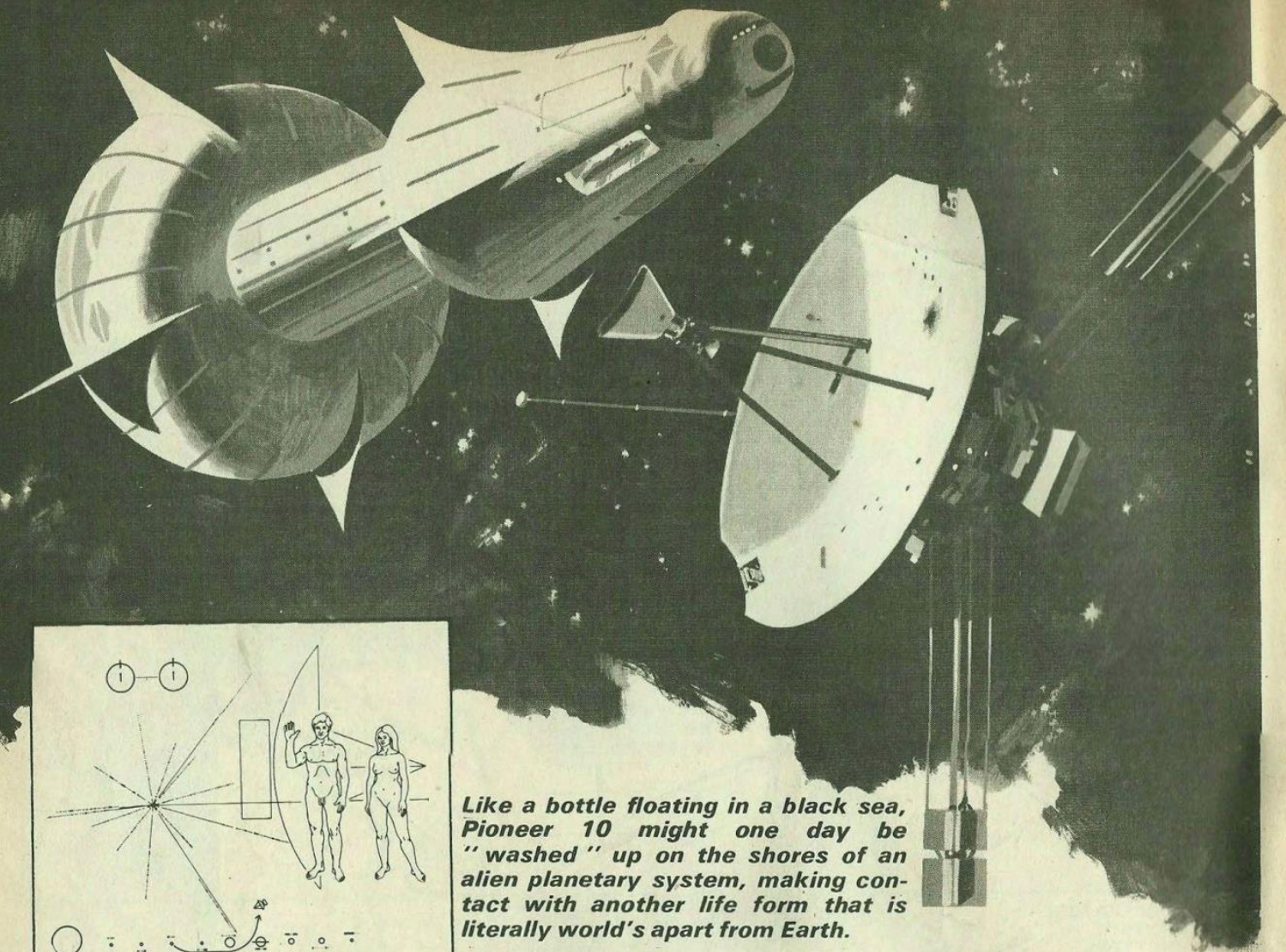
The 570lb spacecraft has an aluminium frame carrying two hexagonal boxes housing the instruments that will carry out 13 different scientific experiments. These two compartments serve as mounting blocks for a nine-foot diameter dish antenna for communicating with Earth, and three extensible aluminium booms,

one of which will carry a magnetometer for mapping Jupiter's magnetic field.

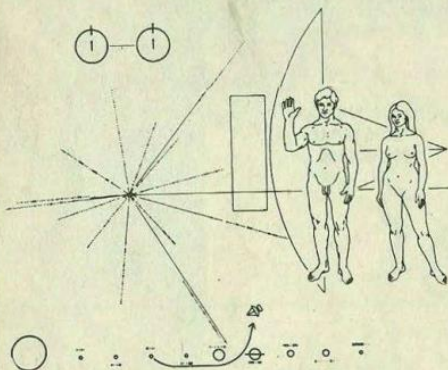
Because of the tremendous distance involved and the length of time needed to reach Jupiter, batteries would be exhausted long before the planet was reached. Solar cells which convert sunlight into electricity would also be unsuitable for at that distance they would gather only one-twenty-seventh of the sunlight we receive on Earth and the cells would need to be as large as football pitches. Instead, the Pioneer is powered by four radio-isotope thermoelectric generators which will produce a total of 120 watts of power. Two each are carried on six-foot long booms that will extend from the spacecraft after launch so as to minimise the effects of their radiation on

CONTINUED ON NEXT PAGE





Like a bottle floating in a black sea, Pioneer 10 might one day be "washed" up on the shores of an alien planetary system, making contact with another life form that is literally world's apart from Earth.



The gold-plated aluminium plaque aboard Pioneer 10. The radiating lines (left) show 14 pulsars (cosmic sources of radio energy) arranged to indicate the Sun as our home star. The figures show who we are and our size in relation to the spacecraft. At bottom are the planets and Pioneer's orbit away from Earth.

the scientific instrument packages.

One of the most dangerous stages for Pioneer 10 will be its passage through a 175 million miles wide asteroid belt which circles the sun some 180 million miles out in space. This belt contains perhaps 50,000 objects with a diameter of at least one mile and hundreds of thousands of smaller fragments. Pioneer 10 will be in this danger zone for some 200 days, but scientists calculate that the chances of a catastrophic collision are less than 10 per cent. However, should a piece of matter only the size of a fist strike Pioneer, the mission could end before it has barely begun.

As Pioneer nears Jupiter on its 620 million mile curving orbit, the instruments aboard will be signalled from Earth and the experiments put into operation. At this distance commands from Earth will take about 45 minutes to reach the spacecraft. One of the mysteries scientists hope will be solved is the Great Red Spot which was first detected on the planet 300 years ago. The Spot seems to float above the planet

and in the last 200 years has circled Jupiter three times. It is a major feature and as it does not seem to be connected directly to the planet, it is of major scientific interest.

Jupiter gives out twice as much energy as it receives from the Sun and scientists are also hoping that Pioneer 10 will establish what internal power source the planet has. The spacecraft might confirm that Jupiter has a very active interior and may have processes at work which are similar to other stars, such as our Sun.

Perhaps the most spectacular data transmitted back to Earth will be eight pictures of the planet showing an area 125 miles in size. Radiation belts, estimated to be a million times stronger than those on Earth, surround Jupiter and these, too, will be examined.

The period of Pioneer's closest approach to Jupiter and the greatest scientific interest will last for about 100 hours. The planet's gravity will then deflect the spacecraft into a wide loop over two-thirds of the planet's surface and accelerate it to a speed which will take it out of the solar system. Pioneer 10 will then continue on its way into deepest space. Eight years after launch it will cross the orbit of Uranus and will then proceed away in a straight line at 25,700 mph until its course is affected by the gravity of another star.

Nothing has been left to chance on this

mission and Pioneer 10 even carries a "label" in case a very remote but possible event takes place — a meeting with an alien craft. The "Label" is a diagrammatic plaque showing where Pioneer 10 comes from and the figures of a man and woman to show the type of beings which inhabit the planet Earth. Like a message in a bottle which has been cast into the sea, Pioneer 10 might one day be "washed" up on the edge of an alien solar system and contact established between two life forms that are literally worlds apart.

STOP PRESS

Since this article was written Pioneer 10 has already travelled well beyond the outer orbit of Mars and has reported some unusual data back to Earth. The asteroid/meteoroid detectors, fitted to the underneath of the dish antenna, consist of 234 pressure cells and to date 41 of these cells have been penetrated by particles of matter, a penetration that is five times greater than scientists calculated. Absence of meteorite contacts while in a curving orbit round Mars also lends proof to the planetary "sweeping effect" theory. According to scientists, galactic particles drifting inwards towards the Sun are attracted by the gravity fields of other planets, like a vacuum cleaner, leaving relatively dust-free zones in space.

MYSTERIES OF THE SEA

MONSTERS FROM THE DEEP

For hours the captain and his crew had pursued the terrifying monster. Now at last, just when it seemed they would succeed in capturing it, it broke free and disappeared beneath the churning ocean—never to be seen again

MONSTERS have been with us from the earliest times, shaking the ground with their heavy tread, or scorching the grass with their fiery breath as they lumber through the pages of every country's mythology. Almost all of them stemmed from the superstitious, simple minds of primitive people who had seen *something* which they literally magnified into a monster when they reported it to their equally scared listeners. We know, for an instance, that the legend of the unicorn owes its existence to someone having seen a rhinoceros.

But what about the great sea monster which countless people have claimed to have seen. Is this also merely a myth? Many people have certainly dismissed it as such, forgetting that myths are stories whose origins are mostly shrouded in the mists of the past. The sea monster, on the other hand, was seen as late as the latter part of the 19th century by hard-headed sea captains whose lives often depended on the accuracy of their eyesight.

It has to be confessed, of course, that the sea monster has been with us for a remarkably long time, which does pose the question that if it had been constantly breeding in the ocean throughout the centuries, why had not one of them ever been hauled aboard?

The early Roman writer, Pliny, mentions one of these creatures which according to him had a head as big as a cask, and tentacles more than 30 feet long. But as he also claims that it was seen to come ashore and then climb a fence, one may, without much difficulty, dismiss this as one of his more imaginative essays.

On the surface, at least, a more reliable

writer was Bishop Pontoppidon, a Norwegian historian who lived in the 18th century. The Bishop had heard tales of a sea monster called the Kraken, but he had openly dismissed them as sheer nonsense. Later, after sifting carefully through all the accounts he had received from the local fishermen, he decided that the sea monster did exist. It was of an enormous size and with horns, the Bishop solemnly informed his readers. It also had tentacles as high as the masts of a large vessel, and these were so powerful that if they were to

lay hold of the largest man of war they would pull her down to the bottom.

From this description it would seem that, like Pliny, we cannot take the good Bishop too seriously. Especially when we bear in mind that he had never seen a sea monster himself. Is it possible that the local fishermen were pulling his leg?

It is only when we come to the 19th century that we have to give some serious consideration to the sea monster. During this period there were a number of "sightings," of them made by highly

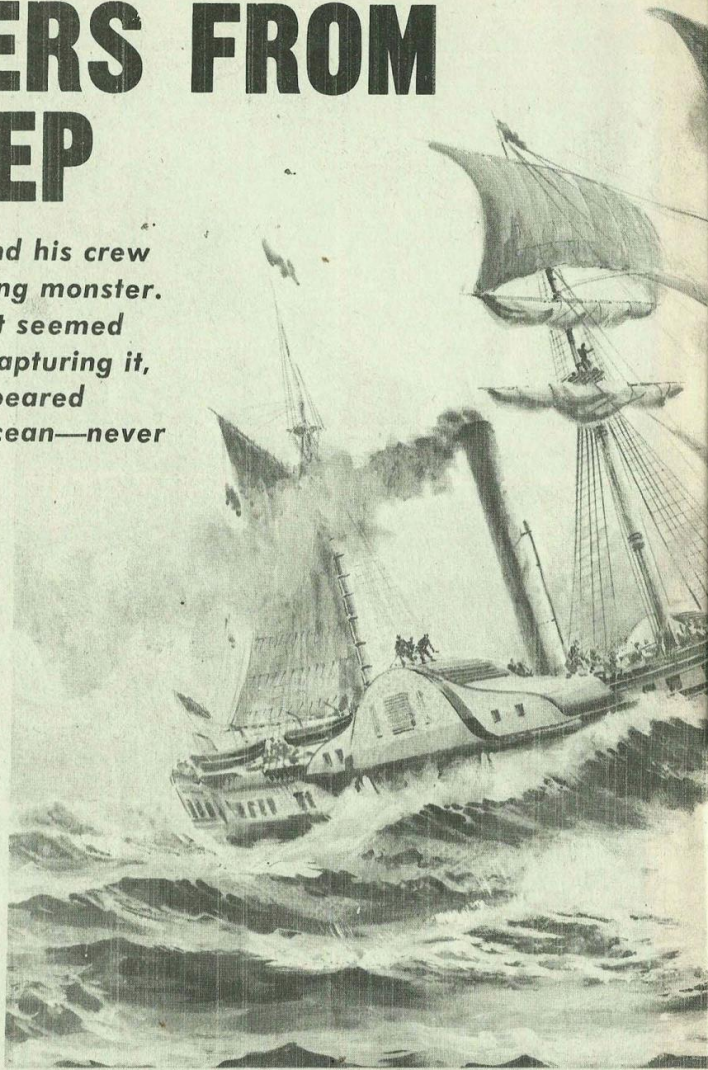
responsible men, whose reports, moreover, were supported by the statements of their crew. One of the most detailed accounts comes from a Lieutenant Bouyer, the commander of the *Alecto*, a man, as far as we know, not given to putting out preposterous stories. On November 30th, 1861, Lieutenant Bouyer was sailing the seas between Madeira and Teneriffe, when he was summoned to the deck rail by an excited member of the crew who pointed out to him a large and terrible looking sea

monster which was swimming alongside. The monster was brick red, between 16 and 18 feet long, and covered with air holes. Its mouth was like a parrot's beak, and nearly a foot and a half in length.

This terrifying sight apparently did not cause Lieut. Bouyer any great alarm. Calmly, he ordered the ship to be stopped, and harpoons prepared. Muskets were also produced, and with these the men first began to pepper the monster which immediately sank from sight. When it surfaced again, it was attacked with

harpoons, which merely bounced off its flesh without inflicting any major injury. Eventually, after they had chased the monster for more than two hours, they put a shot in it which wounded it seriously. This gave them the opportunity to catch it with a slip knot, which slid along the length of its body until it was stopped by its two great fins. But as they began to haul it aboard, it managed to break itself free and disappeared beneath the waters, never to be seen again.

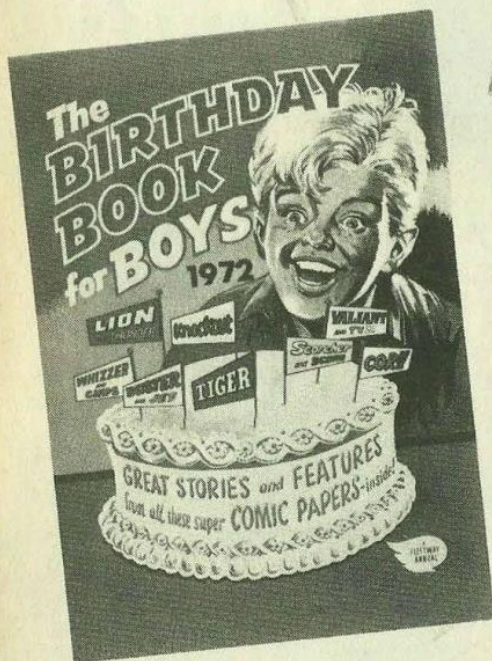
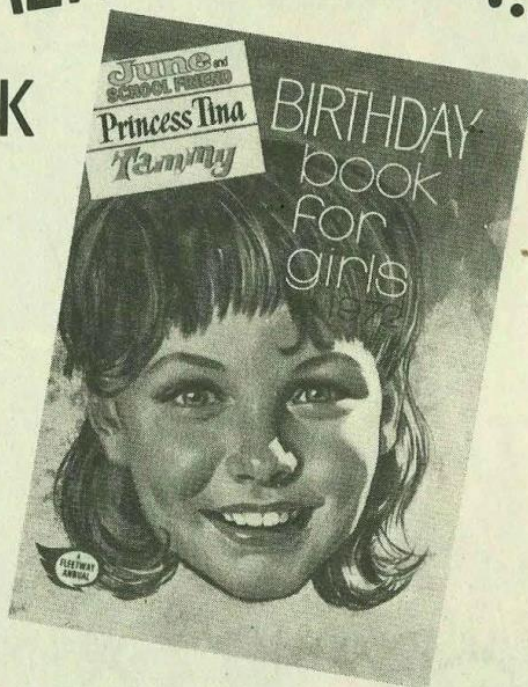
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MYSTERIES OF THE SEA CONTINUED

Although one may wonder why the monster did not simply disappear when it was first attacked, it is difficult to believe that the captain of the *Alecto*, together with the whole of the ship's crew, fabricated the whole story.

Later, in 1873, two fishermen who were working off the coast of Newfoundland, came across a dark mass floating on the surface of the water. One of them was unwise enough to stab at it with a boat-hook, whereupon it opened itself out, revealing itself to be a sea monster with enormous green eyes and a parrot like beak. The monster then extended a set of groping tentacles which fastened themselves on the side of the boat. Finding themselves in danger of being dragged below the surface, one of the horrified sailors struck out savagely with the boat-hook until he had finally managed to sever two of the monster's tentacles. At this point the monster decided that it had had enough and disappeared.

WHAT DID THEY SEE?

One of the tentacles was brought home as a trophy, and on examination it proved to be 19 feet long. After estimating the number of feet that must have remained attached to the body, it was worked out that the monster must have been nearly 45 feet long. Several weeks later a similar monster which had become entangled in a herring net was actually brought ashore, where it was killed, but only with the greatest difficulty.

A number of other encounters with the sea monster were reported throughout the major part of the 19th century. All of them had a number of things in common. They all stated that the monster had a parrot-like beak, and large, baleful eyes, and a set of enormous tentacles. Its size varied a great deal from report to report, but all the sailors were in agreement with one thing. The sea monster existed.

What are we to assume after weighing up all this evidence? Certainly not that there was some giant conspiracy among the sailors of the world to perpetuate a massive hoax. Which leaves us with the undeniable fact that they saw *something*. The question is — what was it they did see?

The size of the monster was probably grossly exaggerated, if only because few people can refrain from embellishing a good story they have to tell. If we therefore considerably reduce the size of the monster, we are left with a creature with tentacles, shapeless and horrible to look upon. What known sea creature would fit this category?

Probably the common squid.

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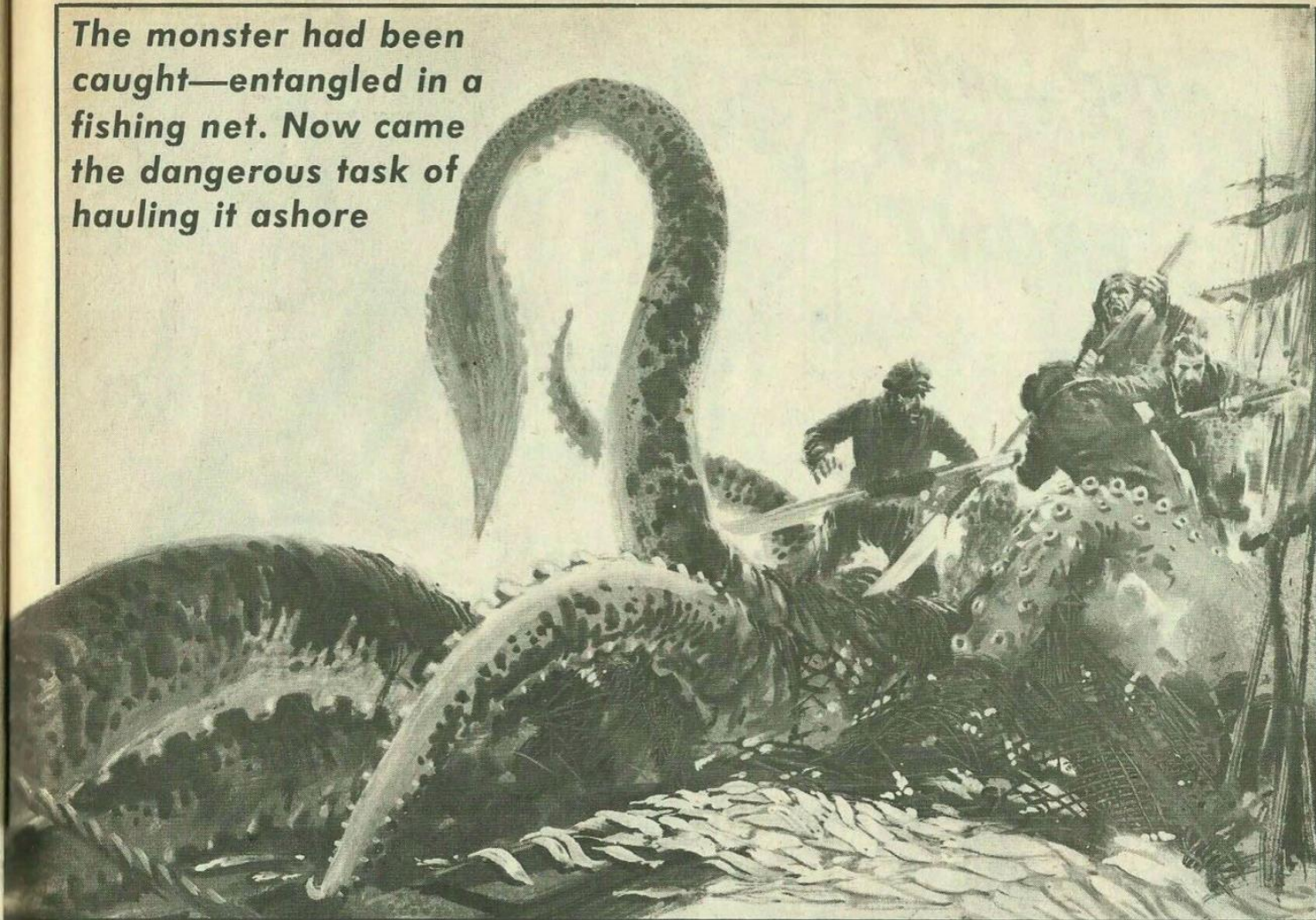
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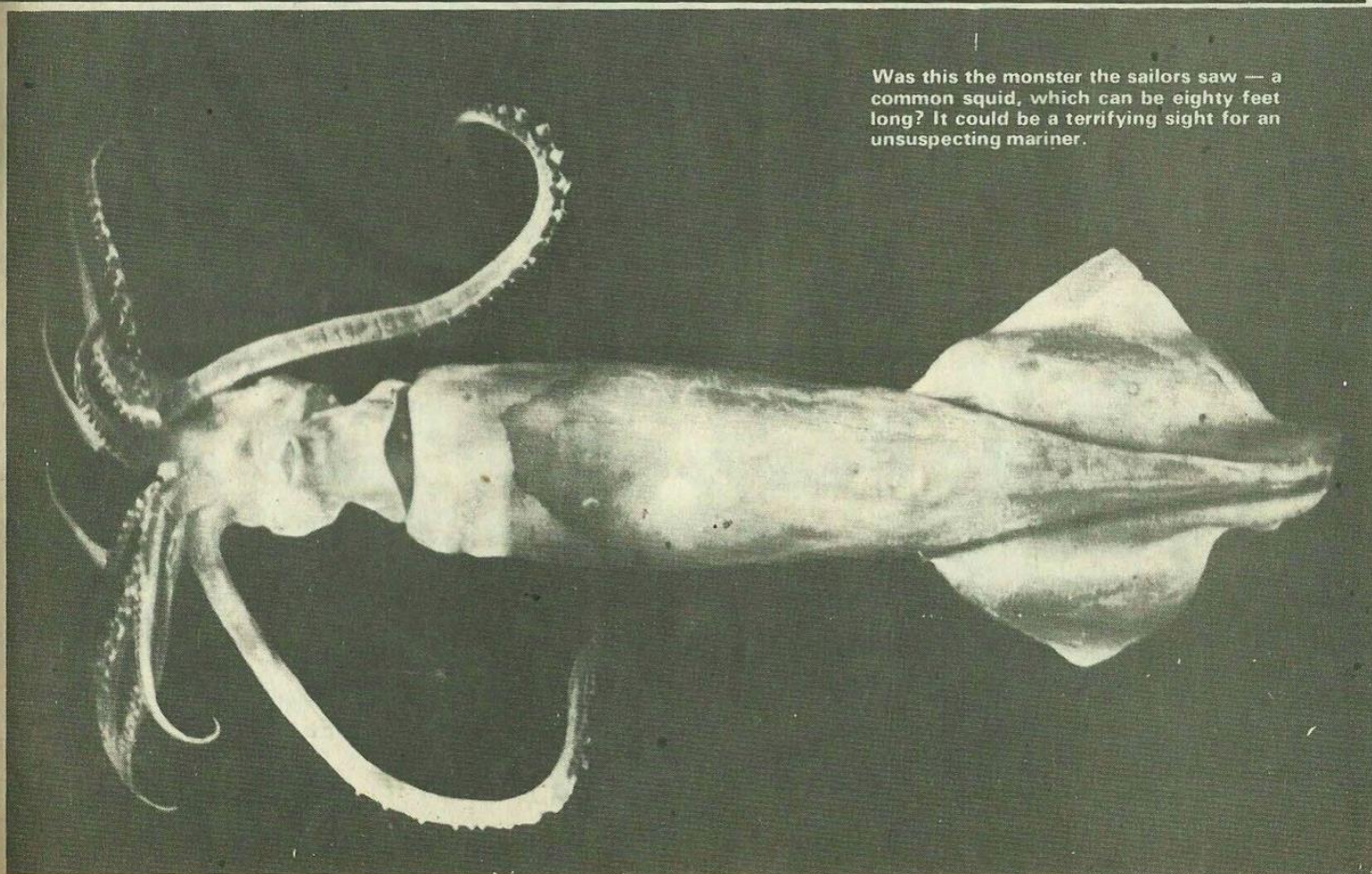
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The monster had been caught—entangled in a fishing net. Now came the dangerous task of hauling it ashore



Was this the monster the sailors saw — a common squid, which can be eighty feet long? It could be a terrifying sight for an unsuspecting mariner.



LOOK LEARN

No. 553, 19th AUGUST, 1972

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**DANGER
FROM
THE SKIES**

SEE INSIDE

LOOKING INTO SCIENCE DANGER FROM THE SKIES

The tremendous power in a flash of lightning can seriously damage and even destroy an aircraft.

It is estimated that the average commercial airliner will be struck at least once by lightning during each year of service, roughly equal to 2,000 to 2,500 hours flying time.

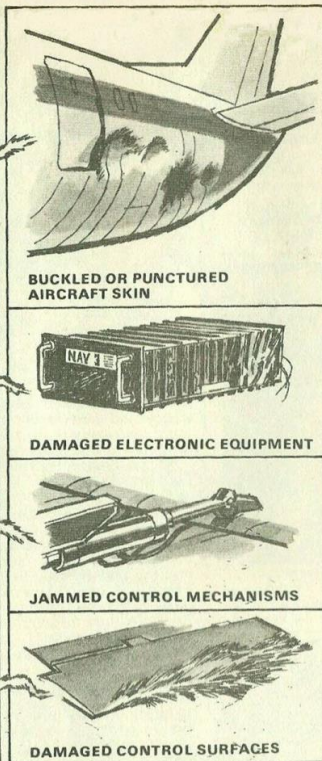
Elusive as the evidence has been, lightning is known to have been the cause of some aircraft crashes that have been blamed on severe air turbulence. Aviation scientists are now devoting more time to the study of in-flight lightning phenomena, particularly as recent information seems to indicate that large aircraft, such as the Boeing 747 "Jumbo" jet, and supersonic airliners, like the Concorde, are likely to receive more than their average quota of lightning strikes.

In aircraft that have metal

"skins" lightning can dent or puncture the metal, jam vital controls, cause severe damage to electrical and electronic equipment and damage the control surfaces on the wings and tail. Moreover the lightning hazards to aircraft are being aggravated by the growing use of materials other than metal. If fibreglass or composite materials, consisting of filaments of boron or graphite embedded in non-conductive resins, are struck by lightning the current cannot flow through them. As a result the materials gradually break down or are totally destroyed by the enormously high electric voltages.

Lightning, which consists of multiple flashes following the same ionised path

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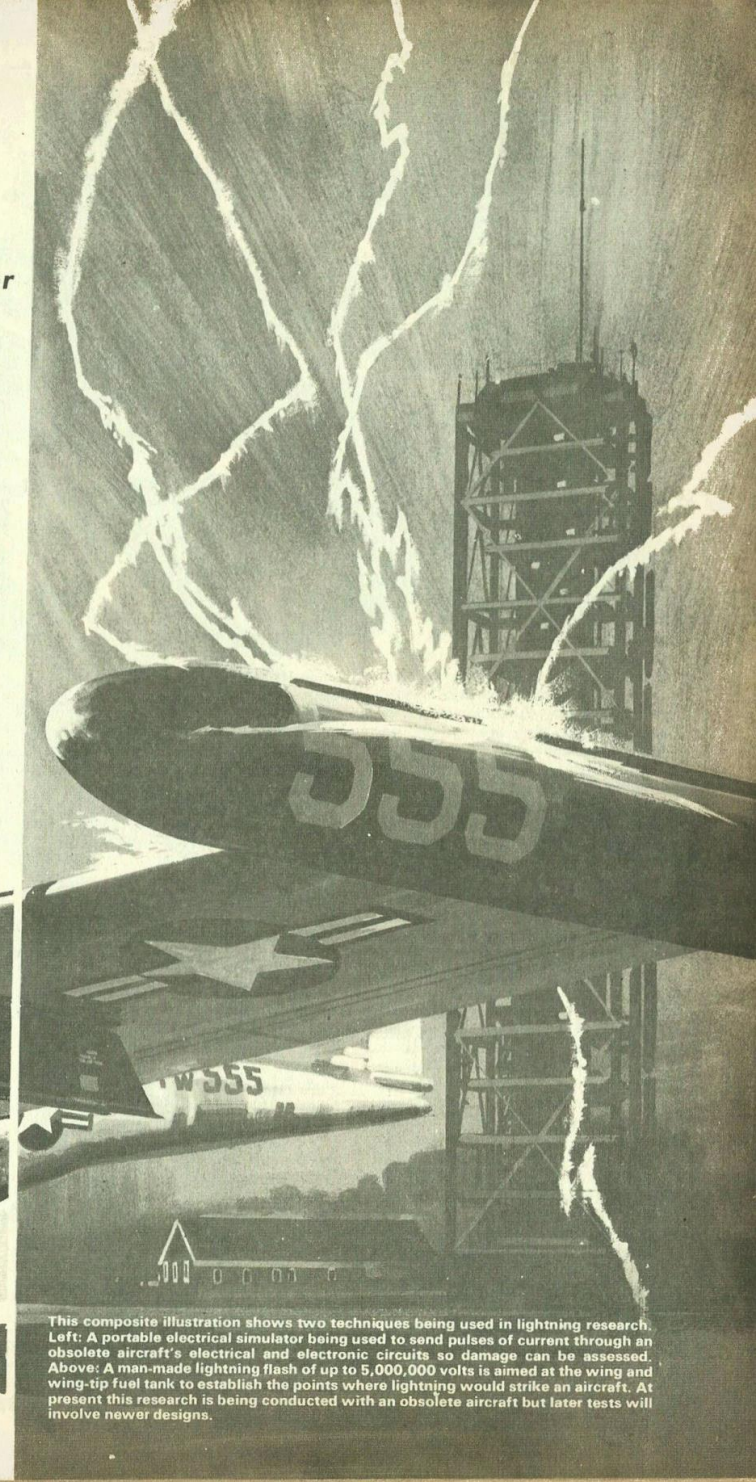
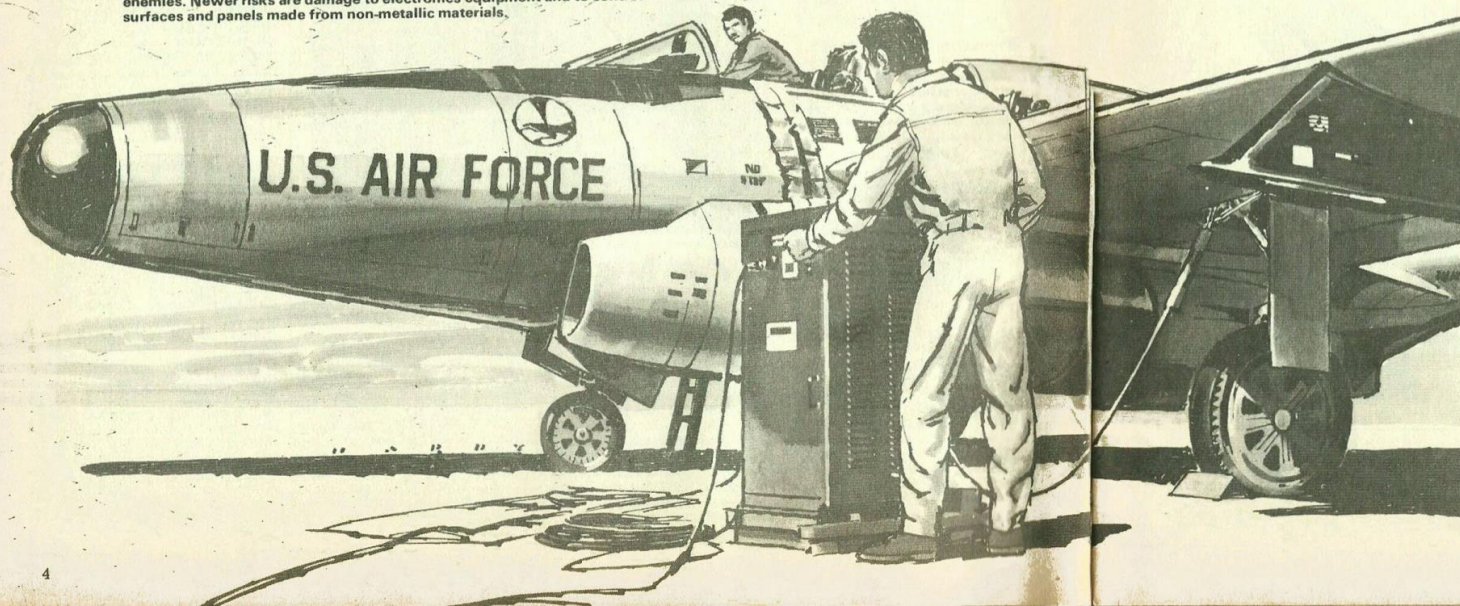
BUCKLED OR PUNCTURED AIRCRAFT SKIN

DAMAGED ELECTRONIC EQUIPMENT

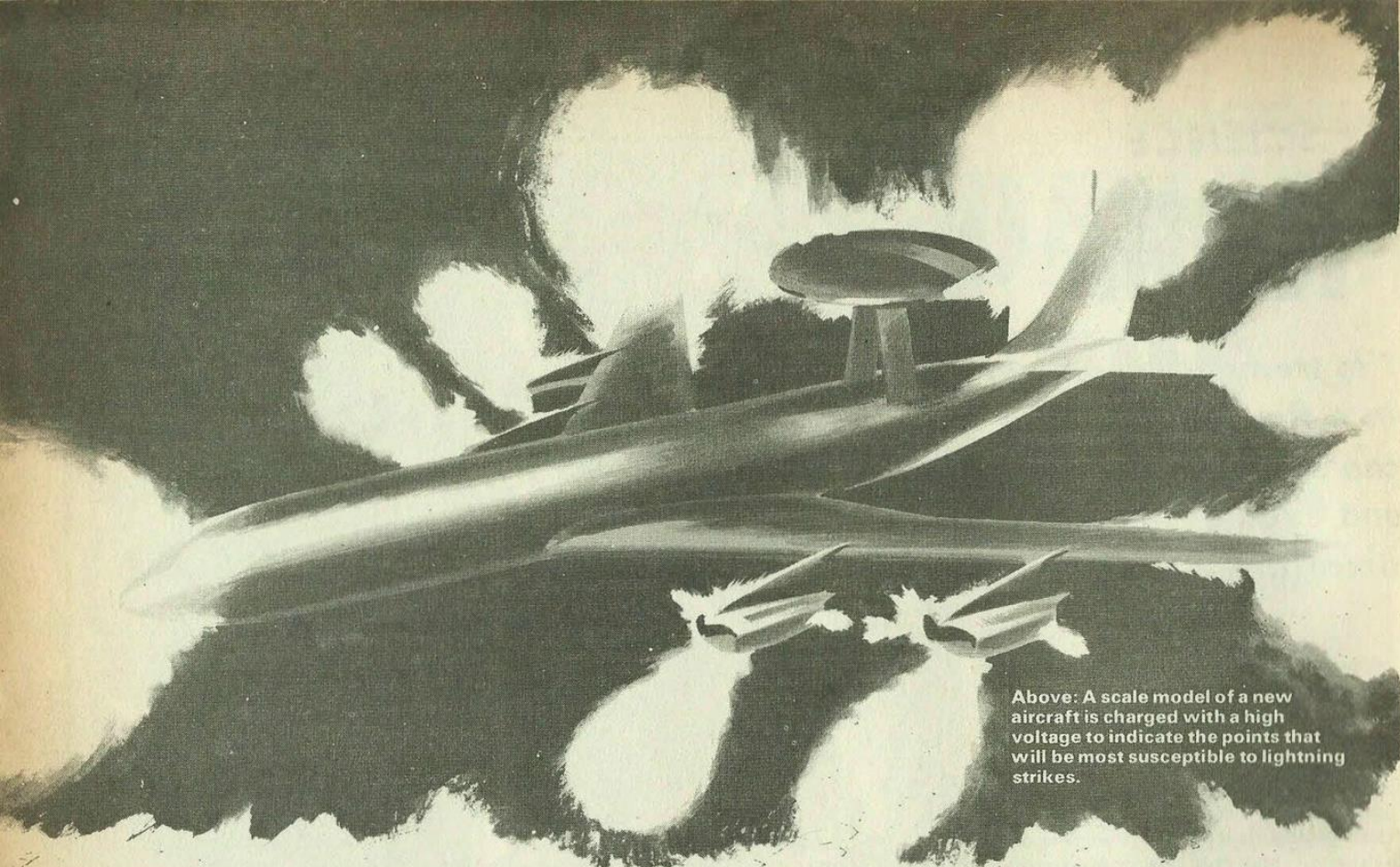
JAMMED CONTROL MECHANISMS

DAMAGED CONTROL SURFACES

Some of the dangers of lightning strikes in mid-air are shown above. Dents and punctures in the aircraft skin and jammed controls are old enemies. Newer risks are damage to electronics equipment and to control surfaces and panels made from non-metallic materials.



This composite illustration shows two techniques being used in lightning research. Left: A portable electrical simulator being used to send pulses of current through an obsolete aircraft's electrical and electronic circuits so damage can be assessed. Above: A man-made lightning flash of up to 5,000,000 volts is aimed at the wing and wing-tip fuel tank to establish the points where lightning would strike an aircraft. At present this research is being conducted with an obsolete aircraft but later tests will involve newer designs.



Above: A scale model of a new aircraft is charged with a high voltage to indicate the points that will be most susceptible to lightning strikes.

through the air, can affect electrical circuits and transistorised navigation and radio equipment, either by direct or indirect contact. In cases where an aircraft's wiring circuit is permanently linked to the rest of the electrical equipment, the lightning can be conducted right through the aircraft. For instance, if lightning should hit the navigation light on a wing tip and get through to the filament of the bulb, it can flow right through the aircraft's wiring to all other pieces of equipment connected to that circuit.

In cases where lightning flows through the metal skin and structure of an aircraft, it can still indirectly interfere or damage aircraft wiring, causing surges of high-voltage electricity to flow into delicate equipment. Older-type aircraft navigation and radio equipment could stand up to this treatment, but the newer transistorised avionics systems are more sensitive. In some cases just 20 volts may prove too much and do irreparable damage.

Even if a lightning strike does not actually destroy a piece of electronic equipment, such as an on-board computer, it might wipe out the computer's magnetic memory banks containing flight information for the aircraft's inertial navigation system. This might cause the aircraft to fly off course if the damage is not quickly detected and rectified.

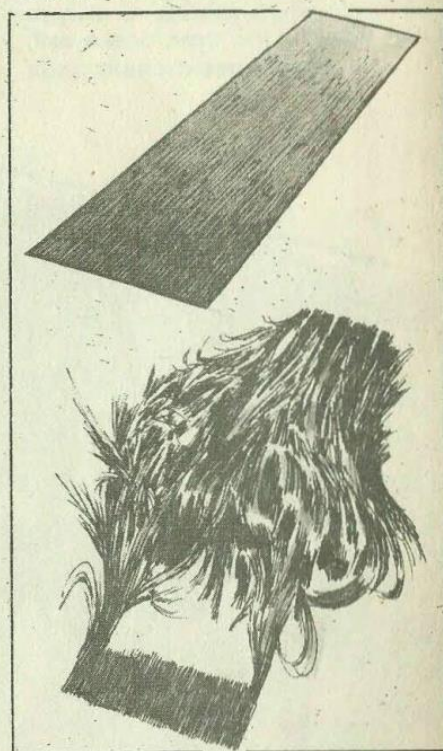
Experiments are now being carried out in the United States to establish just how vulnerable aircraft are to strikes by lightning and to try and find a solution to the problem. At the General Electric High Voltage Laboratory, where currents

equivalent to the power of lightning can be passed through test materials, engineers have developed a portable low-pulse energy generator to simulate lightning voltages on a much reduced scale. Using an obsolete Northrop F-89J aircraft as a test bed, engineers pass these reduced voltages through the airframe and analyse the effects they have on the electrical and electronic equipment.

Researchers feel that one way of combating the destructive effects that lightning has on non-conductive Man-made aircraft materials is to embed fine metal filaments in the compounds so the lightning has a path to follow. Another experimental method involves spraying aluminium on to the non-conductive parts of an aircraft so the lightning can escape along the surface. A third possible solution is the use of one-inch wide aluminium strips, like copper conducting strips on the outside of buildings, which could be fixed to the wings and fuselage to lead the lightning flashes away from vital areas.

At an outside laboratory General Electric uses a lightning generator capable of producing flashes of 5,000,000 volts to study the way in which the flashes hit an aircraft. In most cases it is the extremities, the nose, wing tips and tail, which are struck first before the lightning flashes or arcs over to other parts of the aircraft. Some of these arcs are 100 feet long. They behave far more erratically than short arcs of lightning and it is difficult for the scientists to establish exactly which parts of the aircraft will be struck. Even so they believe that such

Below: This is what happens to an epoxy laminate reinforced with graphite fibres, one of the new man-made aircraft materials, when it is struck by a very high voltage. The epoxy resin burns up leaving a tangled mass of fibres.



experiments are a close representation of the conditions an aircraft will meet while flying through a storm and hope eventually to find a solution to the powerful electrical dangers that lurk in our skies.

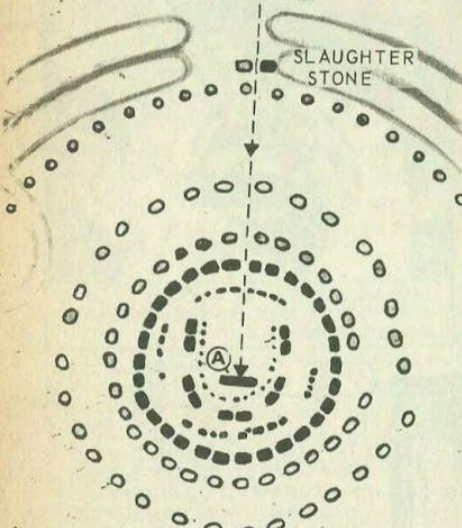


STONEHENGE

PATH OF
MIDSUMMER SUNRISE

HELE STONE

SLAUGHTER
STONE



- (A) ALTAR STONE
- SURVIVING STONES
- MISSING STONES

Some monuments, like the famous Stonehenge on Salisbury Plain (above and top) are aligned with the sun and not the Moon. Using the Hele stone and Slaughter stone like sights on a rifle the exact time of Midsummer's Day could be determined.

The Incredible Stoneage Astronomers

Some 3,500 years ago Neolithic Man led a simple farming life — or so it seemed until it was discovered that the huge stone monuments he left behind him were built with computer-like precision for an astonishing astronomical purpose.

It seems that Neolithic Man, who inhabited Europe about 3,500 years ago, was not the simple farming type that the history books would have us believe. Recent scientific research has shown that these people went to extraordinary lengths to solve the complex problem of the Moon's motion and had an astonishing knowledge of astronomy and geometry.

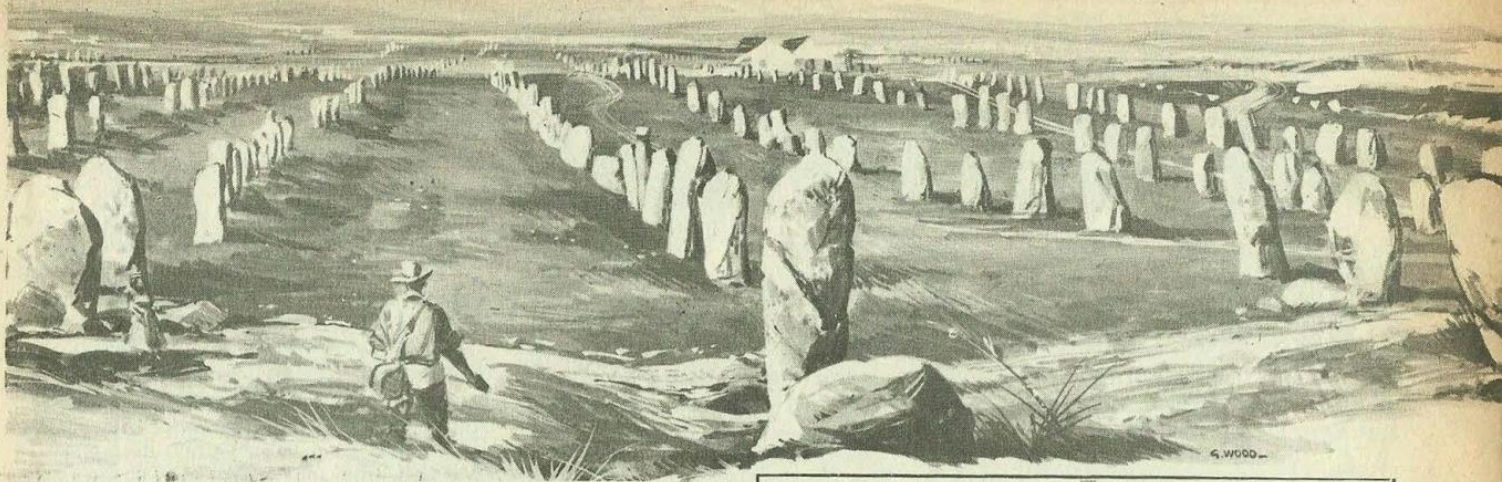
Surveys carried out on Megalithic monuments in Scotland and France show that what seemed to be just geometrical patterns of stones were in fact observatories that were used for determining the Moon's motion. From these findings it has been found these people had a far greater understanding of lunar astronomy than any of their descendants were to have for

the next 3,000 years!

In the 18th century it was realised that Stonehenge, on Salisbury Plain, Wiltshire, was aligned with the mid-summer sunrise and was perhaps used on this day for religious or mystical rites. More recently one expert has suggested that the way the stones are arranged at this famous monument made it possible to predict eclipses of the Sun, an event which would have had a special and awe-inspiring significance for these early peoples.

To understand just how great the problems of building these observatories were for Neolithic Man it is important to know something of the Moon's complicated motion through the sky.

To observers in pre-history the most



striking fact would be that the rising and setting points of the Moon change rapidly from night to night. In the Outer Hebrides, where most of the important Megalithic sites are found, it is possible for the Moon to rise and set almost in the north one day, and then two weeks later it barely manages to rise above the southern horizon for more than a few hours. When it does rise, it appears at different heights in the sky and over a period of 18.61 years goes through a full cycle of different positions and setting and rising points.

Only by constant observations over decades and even centuries could these early stone circle builders establish the reference points needed to construct their observatories.

But why build them at all? It was the information that they were able to gain from these giant stone "calculators" that was important. Eclipses of the Sun and Moon played a great part in their lives. To these Neolithic farmers, an eclipse probably looked like a "great god trying to eat the Sun," which was after all the giver of all life as far as they were concerned. Thus an eclipse of the Sun was an awe-inspiring and fearful phenomenon.

By using their giant "stone protractors" they were able to calculate and determine the paths the Moon would follow through the sky and where it would rise and set. From this they would then know when to expect the next eclipse; on which days mid-summer or mid-winter would fall, so they could divide up the year and find the most favourable times for planting and harvesting; and could work out when the highest and most dangerous tides would occur.

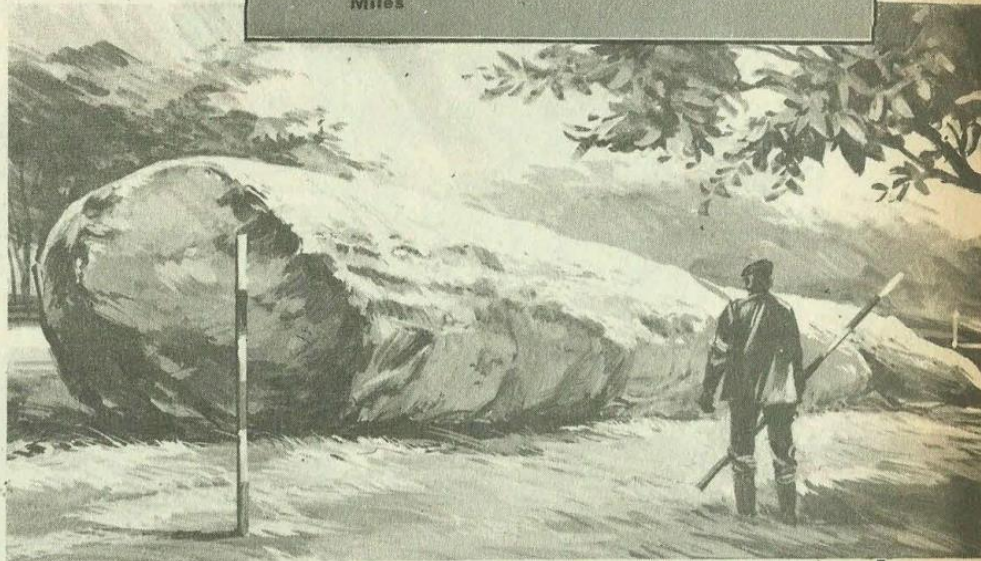
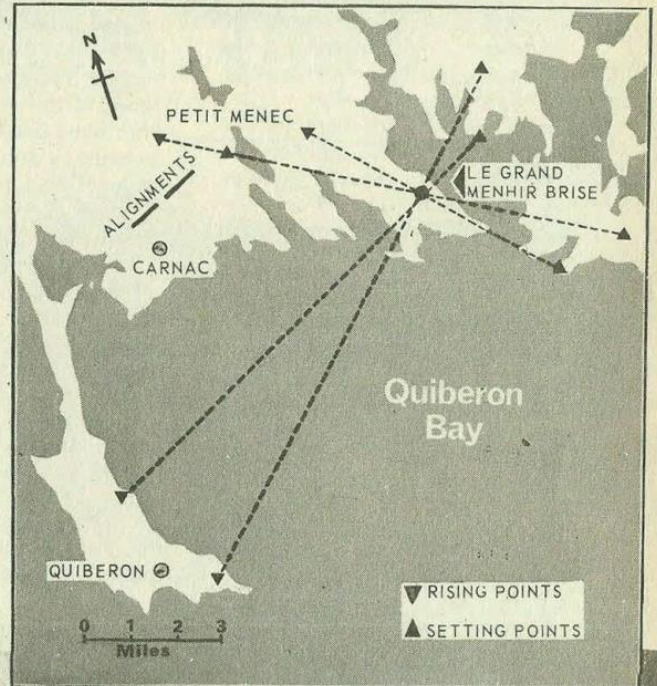
One of the most impressive Megalithic observatories is at Carnac, in Brittany, France. Here are found 12 rows of stones that seem to march solemnly across three miles of countryside. At the heart of this observatory is Le Grand Menhir Brisé, a 67 foot-long stone weighing 340 tons. Quite how these early people managed to man-handle and position such a large stone accurately in the observatory is something of a mystery in itself.

Ringed around Le Grand Menhir are a series of stones and observation platforms, some of which are over 20 feet tall and over 10 miles distant.

Le Grand Menhir acts as a sort of foresight or focus for lunar observations and from here it has been found that the

Above: Carnac, Brittany, where the greatest concentration of Megalithic remains are found. Here 12 solemn rows of stones march across three miles of countryside, marking the rising and setting points of the Moon on the horizon.

Right: A map of a giant lunar observatory laid out by the Neolithic astronomers in France. The sheer size, complexity and above all, accuracy, of this site shows that these early people had an astonishing knowledge of astronomy and geometry. Eight major site lines, four each for the rising and setting points are centred on Le Grand Menhir Brisé, the "keystone" to the observations.



impressive rows of stones that lead away from it line up with the rising and setting points of the Moon on the horizon.

From this evidence and the findings relating to 400 other sites examined in Britain it seems that Neolithic Man was a much cleverer ancestor than archeologists have previously acknowledged.

Le Grand Menhir Brisé, now broken into four parts, was once 67 feet long and weighs 340 tons. The skill and energy needed to move it to the site and then accurately position it must have been tremendous.

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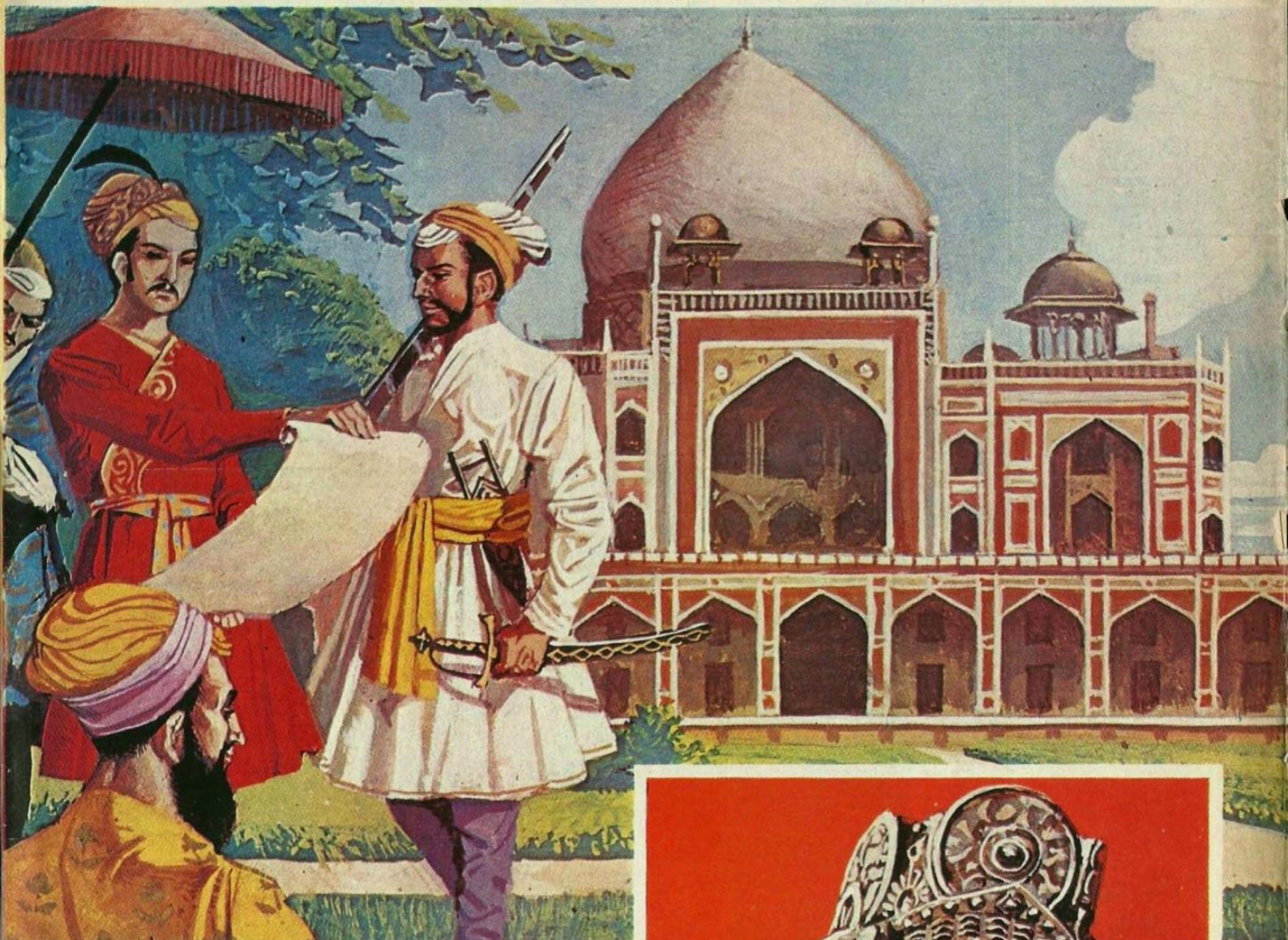
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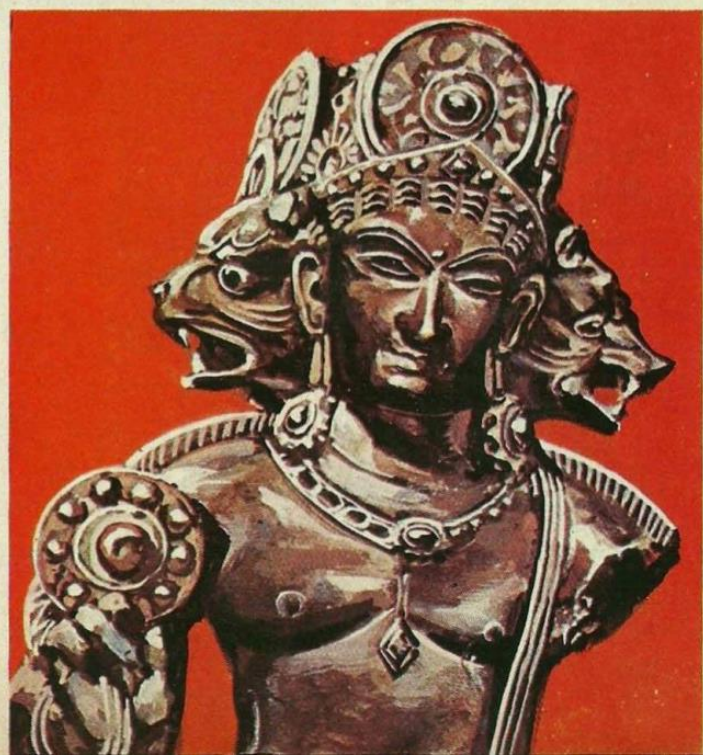
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THE LAND OF THE FIVE RIVERS

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GREAT CIVILISATIONS

SEE INSIDE



Folk Stories of America

The Travelling Monster

There was a Sea Serpent of Gloucester—or so the local people said . . .

VISITORS to Scotland often make their way to Loch Ness, not only to gaze upon the beauty of the scenery but tempted there by the thought that they might be fortunate enough to see the now-famous monster that is thought by some to inhabit the dark waters of the best known of the Scottish lochs. By all accounts many visitors do see the monster. Some claim to have photographed it and the pictures they have produced as evidence have caused considerable controversy. Not only visitors to the Loch claim sightings of "Nessy," but the locals, too, can claim this honour. Some even are said to have observed it many times.

It would seem by the many sightings reported in the past that the Loch Ness monster has or has had cousins the world over. But judging by descriptions perhaps the creature that most deserves the honour of being Nessy's closest relative would be the Gloucester sea serpent of America. According to historical records a monster serpent was seen in the harbour of Gloucester in

Massachusetts about 30 miles to the north of Boston as well as in the nearby Nahant Bay, from as early as the middle of the 17th century and at various intervals for about the next two hundred years.

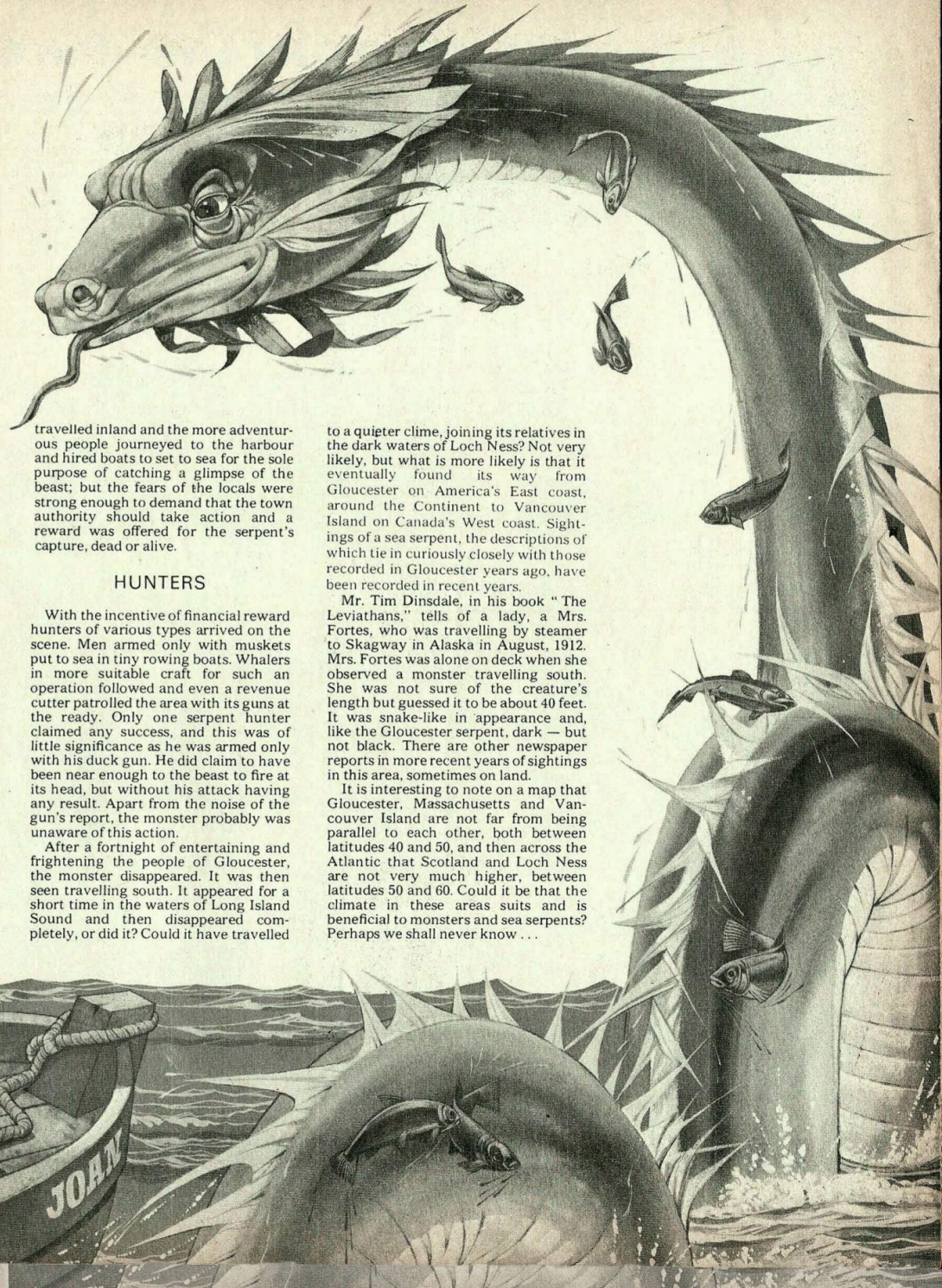
The first recorded account of this creature's appearance occurs in the writings of a Mr. John Josselyn, a visitor to Nahant Bay in 1638. Mr. Josselyn tells of a creature that was seen coiled up on a rock and of an adventurous Englishman who, being on a passing boat at the time, prepared to shoot the beast but was prevented from doing so by an accompanying Indian, who informed the gentleman that to do so would bring them both bad luck.

It was not until 1817 that the Gloucester serpent really drew attention to itself. It would seem that in the summer of that year the monster stayed in the vicinity of Gloucester and Nahant Bay long enough for many people to see it, and even to instill considerable fear into the hearts of the inhabitants of the local towns and villages.

As with the Loch Ness monster, the many sightings of the Gloucester serpent varied considerably in description. Although most reports seem to agree to the size, about 100 feet long and about three feet in diameter, some swore that the creature was much bigger than this. One sea captain claimed that with a six knot breeze blowing and with all sail on it took him a good 15 minutes to sail from the beast's head to its tail.

As with the monster's size, its appearance varied with each description. Most people fortunate enough to have had a sighting virtually agreed upon the colour being dark brown to black. It was also said to have a very smooth skin, a very long tongue and a reptilian head. It was seen mostly in the water, but occasionally some claimed to have seen the beast half on land; a statement, as you can imagine, that did little to quell the fears of the local people. When in the water, it was seen to travel at varying speeds, at other times lazing along.

Soon, news of Gloucester's monster



travelled inland and the more adventurous people journeyed to the harbour and hired boats to set to sea for the sole purpose of catching a glimpse of the beast; but the fears of the locals were strong enough to demand that the town authority should take action and a reward was offered for the serpent's capture, dead or alive.

HUNTERS

With the incentive of financial reward hunters of various types arrived on the scene. Men armed only with muskets put to sea in tiny rowing boats. Whalers in more suitable craft for such an operation followed and even a revenue cutter patrolled the area with its guns at the ready. Only one serpent hunter claimed any success, and this was of little significance as he was armed only with his duck gun. He did claim to have been near enough to the beast to fire at its head, but without his attack having any result. Apart from the noise of the gun's report, the monster probably was unaware of this action.

After a fortnight of entertaining and frightening the people of Gloucester, the monster disappeared. It was then seen travelling south. It appeared for a short time in the waters of Long Island Sound and then disappeared completely, or did it? Could it have travelled

to a quieter clime, joining its relatives in the dark waters of Loch Ness? Not very likely, but what is more likely is that it eventually found its way from Gloucester on America's East coast, around the Continent to Vancouver Island on Canada's West coast. Sightings of a sea serpent, the descriptions of which tie in curiously closely with those recorded in Gloucester years ago, have been recorded in recent years.

Mr. Tim Dinsdale, in his book "The Leviathans," tells of a lady, a Mrs. Fortes, who was travelling by steamer to Skagway in Alaska in August, 1912. Mrs. Fortes was alone on deck when she observed a monster travelling south. She was not sure of the creature's length but guessed it to be about 40 feet. It was snake-like in appearance and, like the Gloucester serpent, dark—but not black. There are other newspaper reports in more recent years of sightings in this area, sometimes on land.

It is interesting to note on a map that Gloucester, Massachusetts and Vancouver Island are not far from being parallel to each other, both between latitudes 40 and 50, and then across the Atlantic that Scotland and Loch Ness are not very much higher, between latitudes 50 and 60. Could it be that the climate in these areas suits and is beneficial to monsters and sea serpents? Perhaps we shall never know . . .



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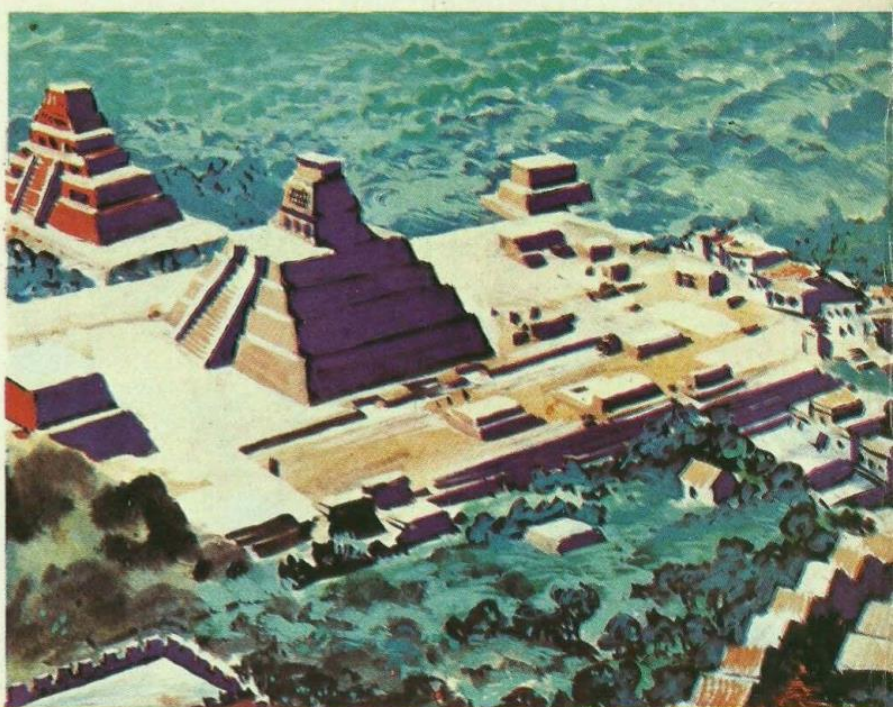
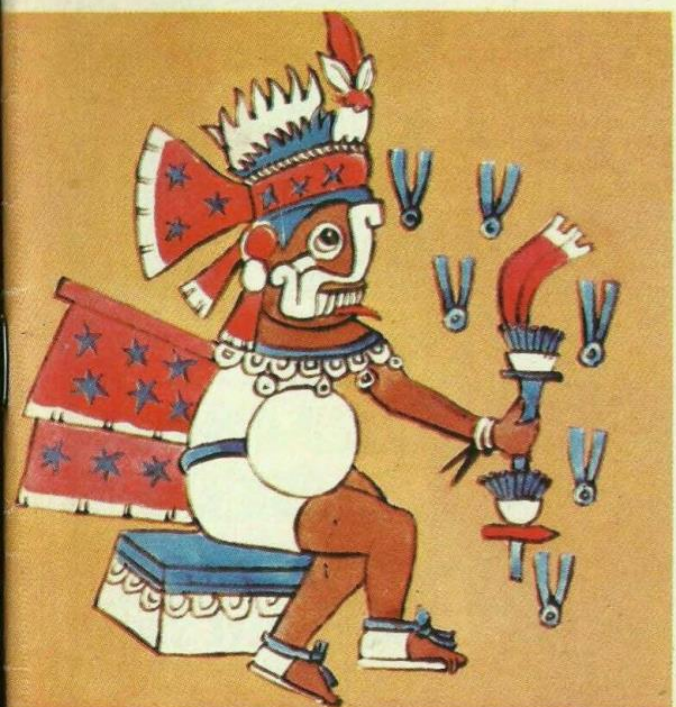
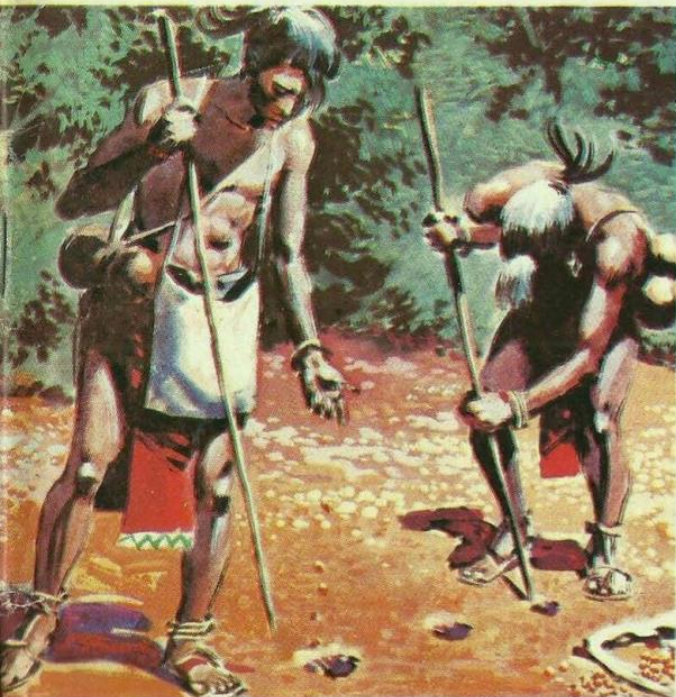
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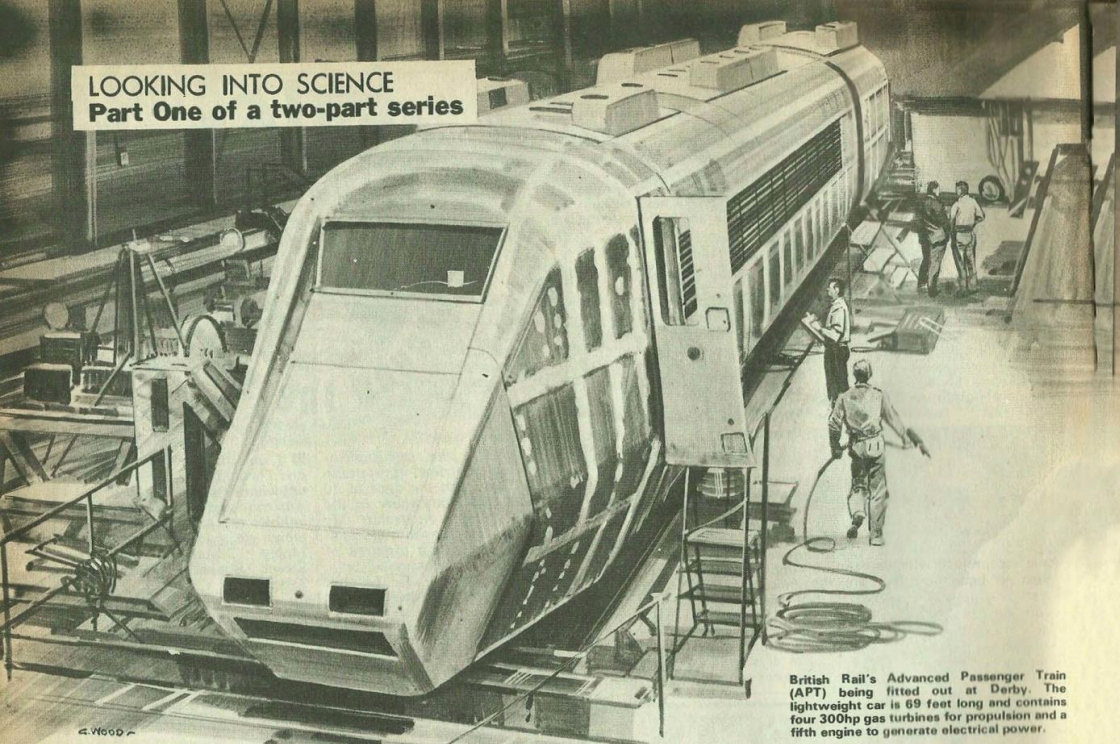


TEMPLES IN THE SUN

ANOTHER IN OUR SERIES ABOUT THE WORLD'S GREAT CIVILISATIONS
SEE INSIDE

LOOKING INTO SCIENCE

Part One of a two-part series

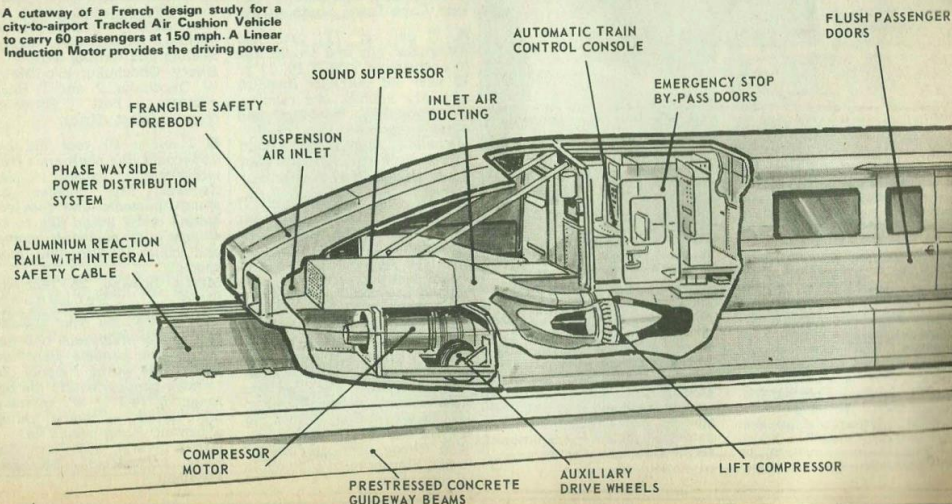


British Rail's Advanced Passenger Train (APT) being fitted out at Derby. The lightweight car is 69 feet long and contains four 300hp gas turbines for propulsion and a fifth engine to generate electrical power.

In this feature we look at the development of fast rail transport

THAT WAS THE 9.40 THAT WAS...

A cutaway of a French design study for a city-to-airport Tracked Air Cushion Vehicle to carry 60 passengers at 150 mph. A Linear Induction Motor provides the driving power.



FAR FROM giving the mass of people greater mobility, the growth of road and air traffic is slowly leading to a lessening of freedom because of inadequate roads and airports. In 1919, a trip between central Paris and central London could be undertaken at an average speed of 48 mph. In 1960, that speed had only risen to 65 mph, even though aircraft cruising speeds have risen from 77 mph to 480 mph over the same period.

The problem has not been the time spent in flight, but the time taken to get to and from the airports by road.

Experts now consider that high-speed railways are the answer to the problem. Motorists, in ever-increasing numbers, are demanding more miles of motorway. On the other hand, the railways already have a network of tracks which can be improved for high-speed operation.

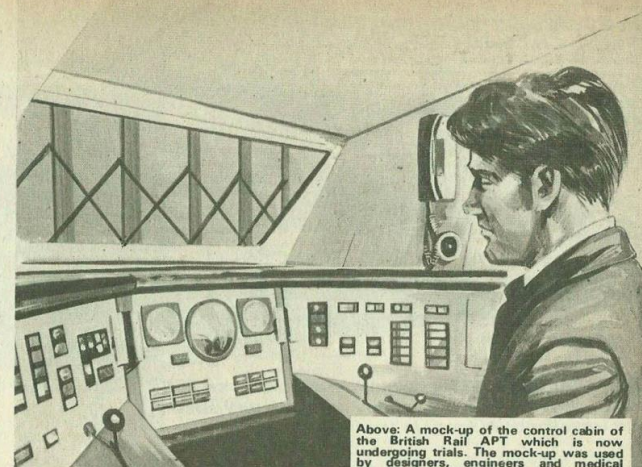
The new High-Speed Surface Transport (HSST) systems can be roughly divided into two types — those relying on conventional railway tracks which can be improved for high-speed trains, and tracked trains, or monorails, which float along on a cushion of air or are magnetically supported and propelled by linear induction motors (LIM) or shrouded propellers.

Two new projects which are perhaps the nearest to becoming fact are the Advanced Passenger Train (APT) of British Rail and the Aerotrak Tracked Air Cushion Vehicle (ATACV) in France.

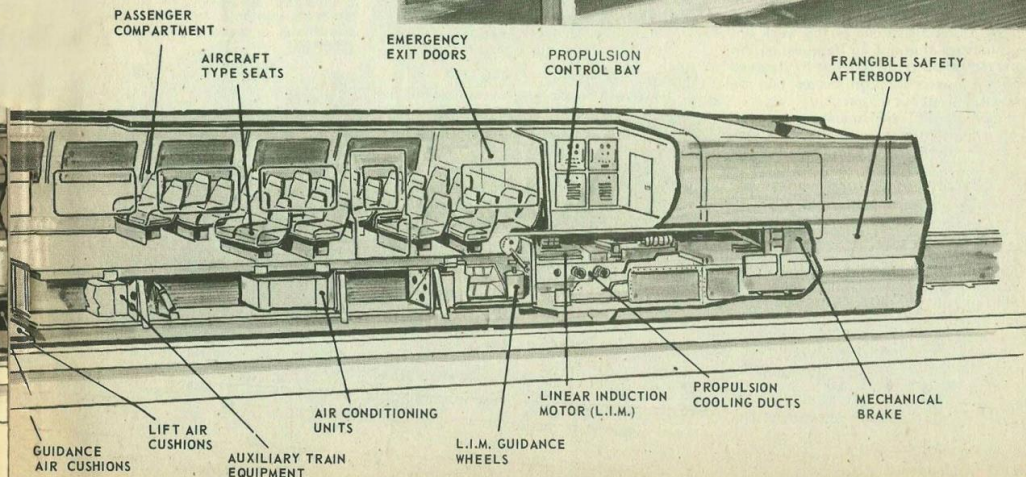
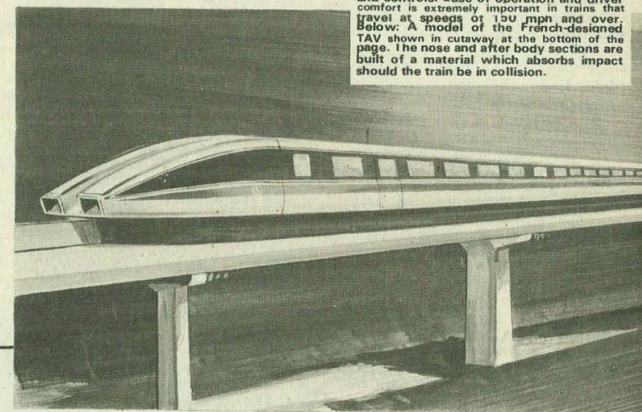
For speeds up to 280 mph, the APT, because it is able to operate over existing track, is the favourite. Average speeds of 155 mph will provide centre to centre travel which may be faster than that offered by airlines. Longer distances, up to 370 miles, operated at speeds up to 250 mph favour the use of ATACVs.

The four-car British Rail APT has two, 69 foot-long power-cars each fitted with 300 hp gas turbines connected to generators

CONTINUED ON NEXT PAGE



Above: A mock-up of the control cabin of the British Rail APT which is now undergoing trials. The mock-up was used by designers, engineers and medical experts to study the layout of instruments and controls. Ease of operation and driver comfort is extremely important in trains that travel at speeds of 150 mph and over. Below: A model of the French-designed TAV shown in cutaway at the bottom of the page. The nose and after body sections are built of a material which absorbs impact should the train be in collision.



This locomotive, built in Belfast, is in service with the French railways. It can be used on existing rails but for maximum high-speed operation it needs new track of a special design.



Speeds of 150 mph for conventional trains and 250 mph for Tracked Air Cushion Vehicles will speed the traveller on his way in tomorrow's world

which drive electric motors and the wheels. A fifth engine is used to generate electrical power for use inside the train. It is planned to introduce these APTs on inter-city routes by 1974, running at an average speed of 155 mph and cutting down the 400 miles London to Edinburgh run from five hours 45 minutes to three hours 40 minutes.

One of the most important points to remember with high-speed trains is not the speed reached on straight track, but whether that speed can be maintained around curves, whether the centrifugal effects will make the passenger uncomfortable and whether existing signalling is capable of stopping such a high-speed train in time.

To overcome these problems, the APT has some interesting new features. A lot of research has gone into designing wheels and self-steering bogies that will take the train safely round curves at high-speed and a special suspension system that tilts the train up to nine degrees from the horizontal to counteract the centrifugal forces. Curved sections of the track are also banked at about 10 degrees, so the total tilt will be in the order of 17 degrees and the speed through curves can be increased by about 50 per cent.

Since the APT will operate over track with conventional signalling systems, this means it must be able to stop as quickly as an ordinary 100 mph train. To achieve this, the axles are fitted with hydro-kinetic brakes. A finned disc, like a turbine blade attached to the axles, is enclosed in a chamber, and when fluid is fed into this, the spinning blades are slowed down. At the same time, the fluid heats up, because it is dissipating the energy of the speeding train, so it is led away to be cooled in radiators in the car body. This system provides a smooth and quick deceleration.

Acceleration is also an important factor in maintaining an average speed, and by adopting a lightweight, almost aircraft-type of structure, the builders have been able to get the required performance with a relatively modest power plant. The structural weight of the APT is about half that of conventional trains.

Since 1967, the French have had a

prototype Tracked Air Cushion Vehicle (TACV), called the aerotrain, operating on a 11.5 miles section of the future Paris to Orleans line. Over 700 hours of testing have already taken place and more than 8,000 passengers have travelled in the vehicle.

The Aerotrain rides on a "T" shaped beam supported above the ground by concrete pylons. Instead of running on wheels it "floats" along, like a hovercraft, on cushions of air, straddling the "T" beam for guidance.

The driving power comes from two 1,300 hp turbines driving a seven-bladed shrouded propeller at the rear of the train. A third turbine supplies the air needed for the lift. This vehicle has travelled at 235 mph, and with a rocket booster has reached 263 mph!

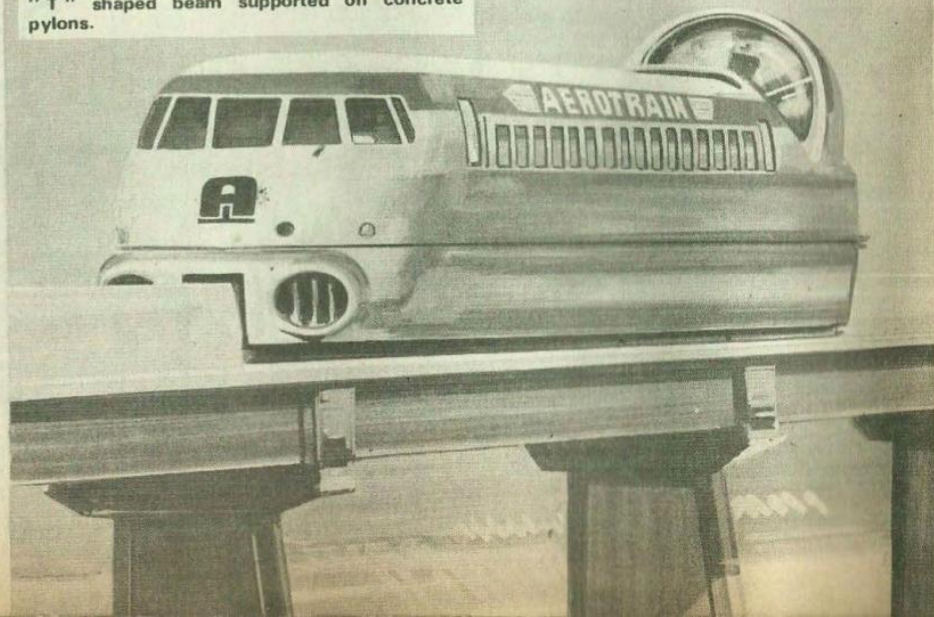
But perhaps the most exciting development in HSST is a French-designed prototype train for use on city-to-airport services in the United States. This has a 60 passenger lightweight cabin fitted with aircraft type seats and is propelled by Linear Induction Motors (LIM).

The train rides on a cushion of air,

supplied by a compressor, so there is no friction to overcome. To brake the train, the current is reversed in the linear induction motor and there will also be a mechanical brake. The train will be automatically controlled and the front and rear of the train will be fitted with special collapsible body sections to minimise damage in the event of a collision. Top speed will be about 150 mph.

The main advantages of TACVs, whether driven by linear induction motors or propellers, are their high speeds, the ease with which they can be controlled automatically and the light-weight easily constructed tracks which can be built over existing railways and roads. In Britain, at least, the use of TACV will probably be limited to a new transport system designed to connect the New London Airport at Foulness with London, a distance of 50 miles. The APT trains which make use of existing tracks are a firm prospect for the 1980s. With the opening of the channel tunnel, they could seriously compete with the airways for short-haul operations between London and Paris.

Since 1969 the propeller-driven Aerotrain has carried 8,000 passengers and reached a speed of 263 mph with a rocket booster. It travels on a "T" shaped beam supported on concrete pylons.



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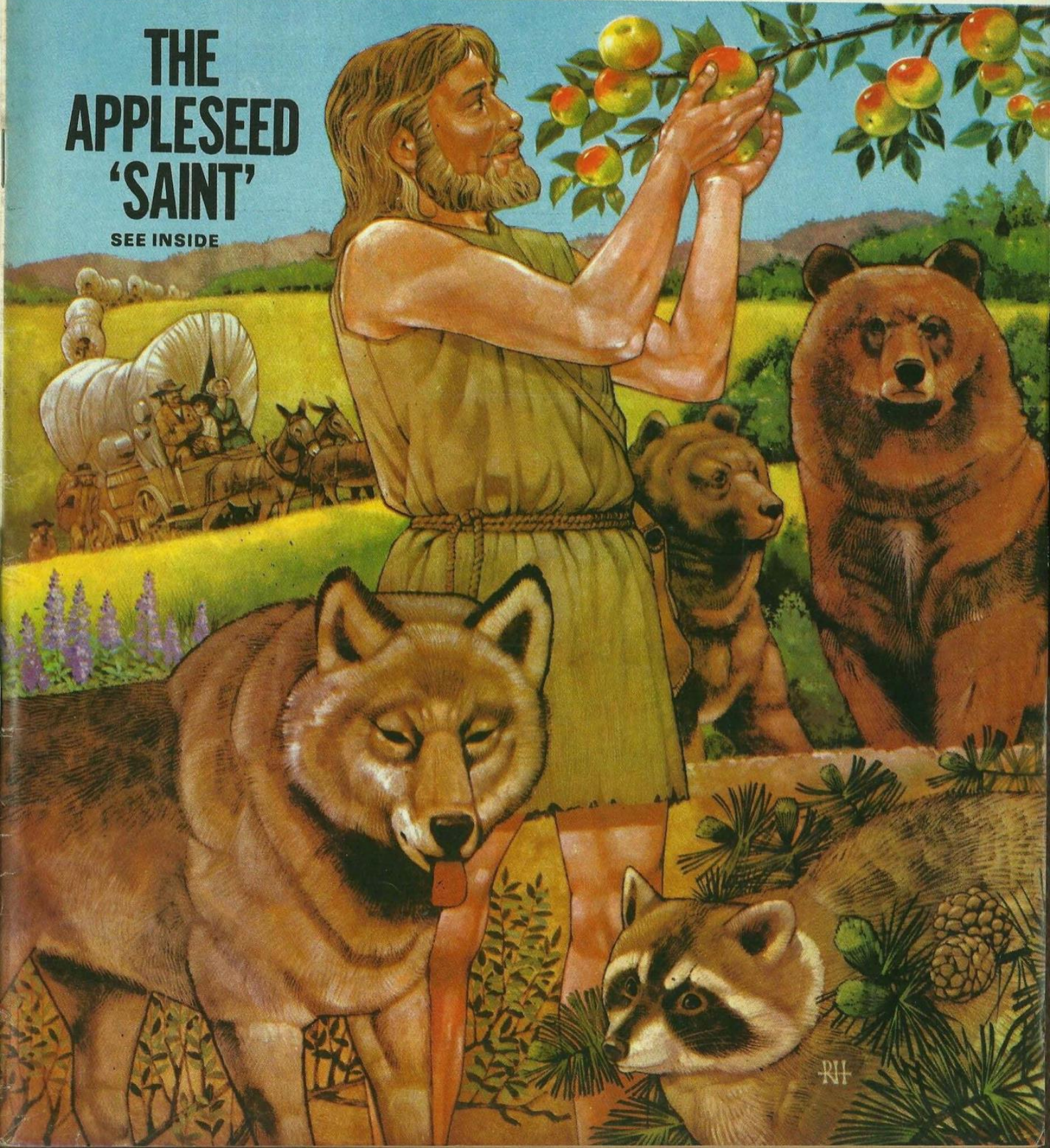
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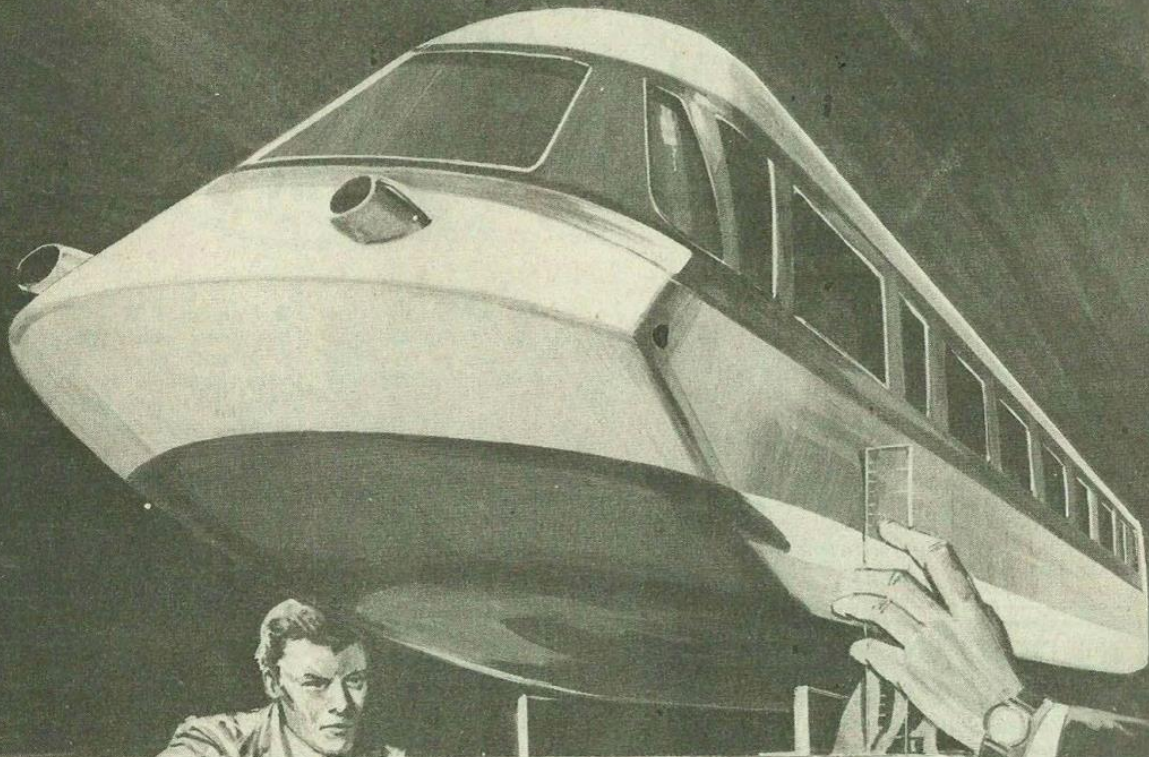
THE APPLESEED 'SAINT'

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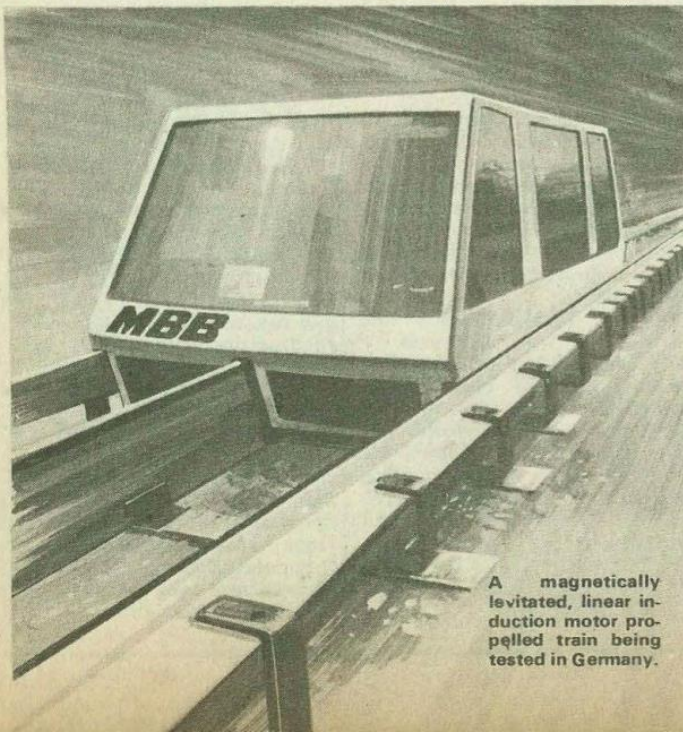


LOOKING INTO SCIENCE

Trains without wheels



Steam has gone from the railways, and within a few years diesels and ordinary electric locomotives may vanish to make way for trains that float above the rails and are pushed along by a powerful, invisible force



A magnetically levitated, linear induction motor propelled train being tested in Germany.

HERE are two mind-bogglers to set your mental cogwheels whirring: magnetic levitation and linear induction.

Before you shudder and hurriedly turn to the "Trigan Empire," let's hastily add that some of the exciting things that happen in that far off planet could not occur if the scientists had not wrestled with the problems behind such terms. And, although on earth we may not be as scientifically advanced as the fictional Trigans, we may have to use magnetic levitation and linear induction to make our trains of tomorrow go faster.

In any case, the trains you see on this page do not seem very far removed from our artist's idea of what the Trigan Empire is like.

So, let us clear our minds of the scientific jargon and see what magnetic levitation and linear induction really are.

Magnetic levitation is a way of running a train without wheels. Wheels are a very fine invention, but they do slow a vehicle down, as you can see when you compare the speed of a train with that of an aircraft.

If you lift the train off the track and keep it held in the air by powerful magnets, you can cut out any resistance between the track and the train. The way is now clear for faster speeds.

But how can you make such a train go along, short of giving it a propeller or putting a roaring jet behind the guard's van?

Easy! The same magnetism which holds the train off the track can push it along.

The train floats by magnetism and is pushed along by magnetism. That is what all those complicated sounding phrases "magnetic levitation" and

Magnetism will be a secret behind the trains of the future. It will support them above the track and push them along at great speeds without the hindrance of wheels

linear induction" are.

Engineers have toiled for a long time to develop these ideas so that they work properly. They are still in the experimental stage. But they are being studied in Britain, America and elsewhere and it seems likely that sometime in the future we shall travel by magnetic power.

How does the linear induction motor work? If you have ever made a small electric motor or taken one apart, you will know that it consists of a core of soft iron surrounded by copper conductors. This is called an armature. Around this is a horseshoe of soft iron surrounded by a coil of wire. When an electrical current is passed through the coil, the horse shoe becomes a magnet and turns the armature.

The linear induction motor works on the same principle. Instead of a revolving armature, however, it uses one rail of the railway track as an armature.

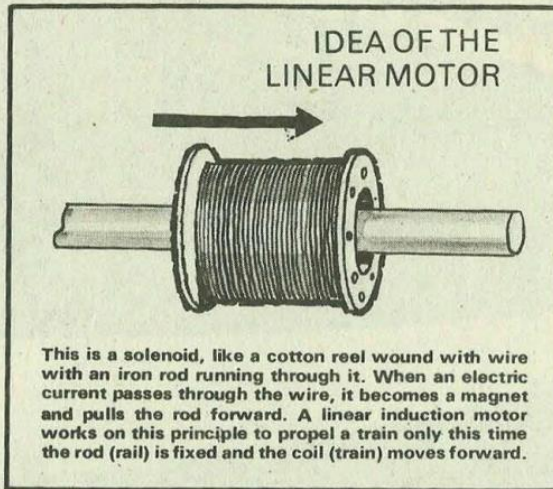
INVISIBLE FORCE

An electro-magnet (like our horseshoe in its coil of wire) pushes on to the track to thrust the train along.

You can get a better idea of this if you think of the solenoid. In this, a current is passed through a coil of wire. This sets up magnetism to pull a loose iron rod inside the core, possibly with the power of several thousand pounds.

This is the pulling action which tugs with invisible force at the railway line to set the train moving at great speeds.

Germany is leading the field with this work, although the scientists of British Rail are also well ahead with this form of research.



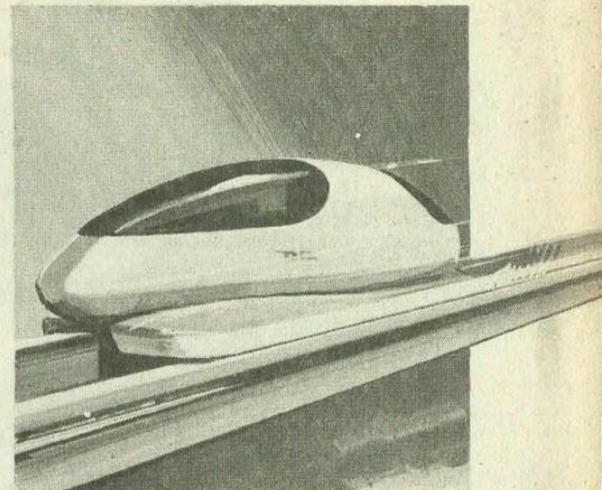
However, Germany can claim to have the first full-scale magnetically-levitated vehicle in the world, propelled by linear induction.

You can see how advanced these ideas are when you know that the first prototype train of this type will not be ready until 1977. One reason for this is that although the vehicle could be finished before that date, the track will be very costly to construct, and the Federal German Government has not yet agreed to the building of a 44 mile test track.

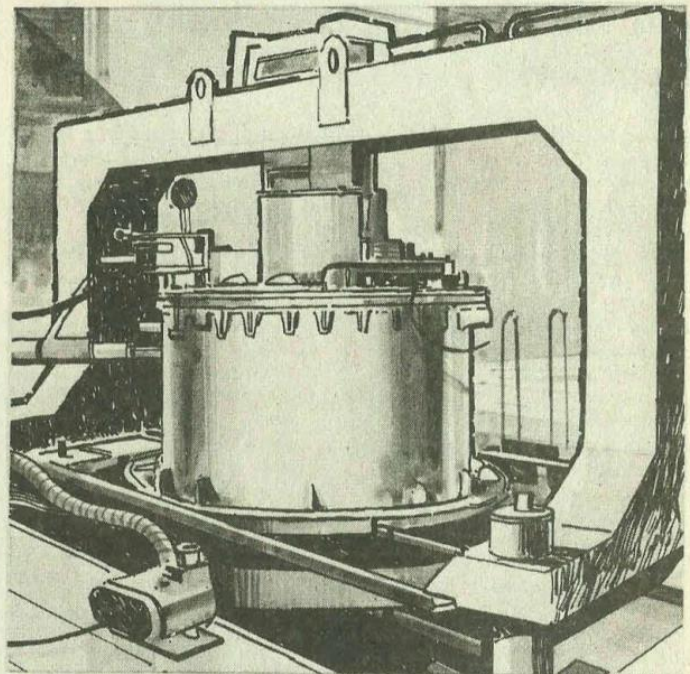
The company making the tests, however, has decided that magnetic levitation is a better prospect for the future than the air cushion trains we described last week.

One country going ahead with this system is Japan, which is world famous for its network of high speed trains, which go so fast that the wheels have to be reground almost every day. Small wonder, then, that they are

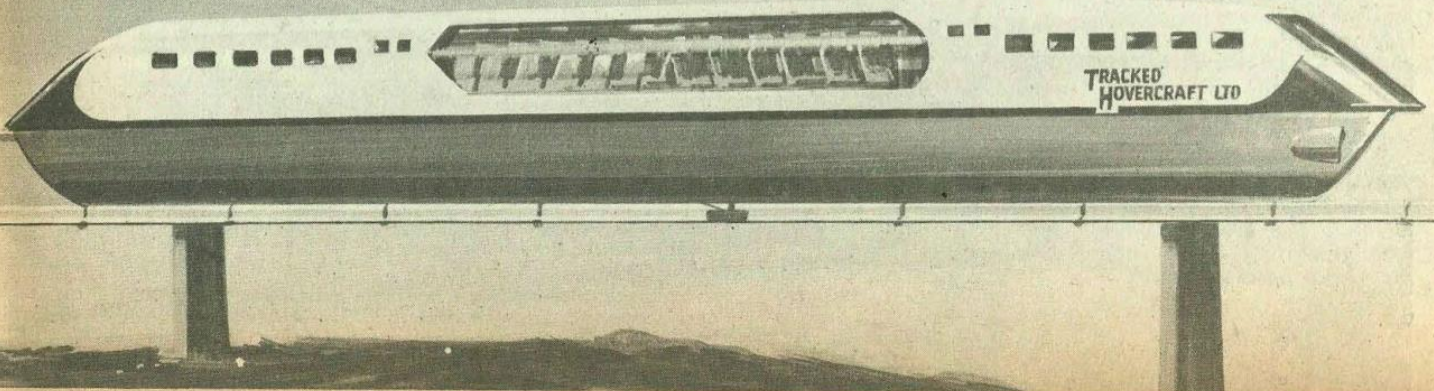
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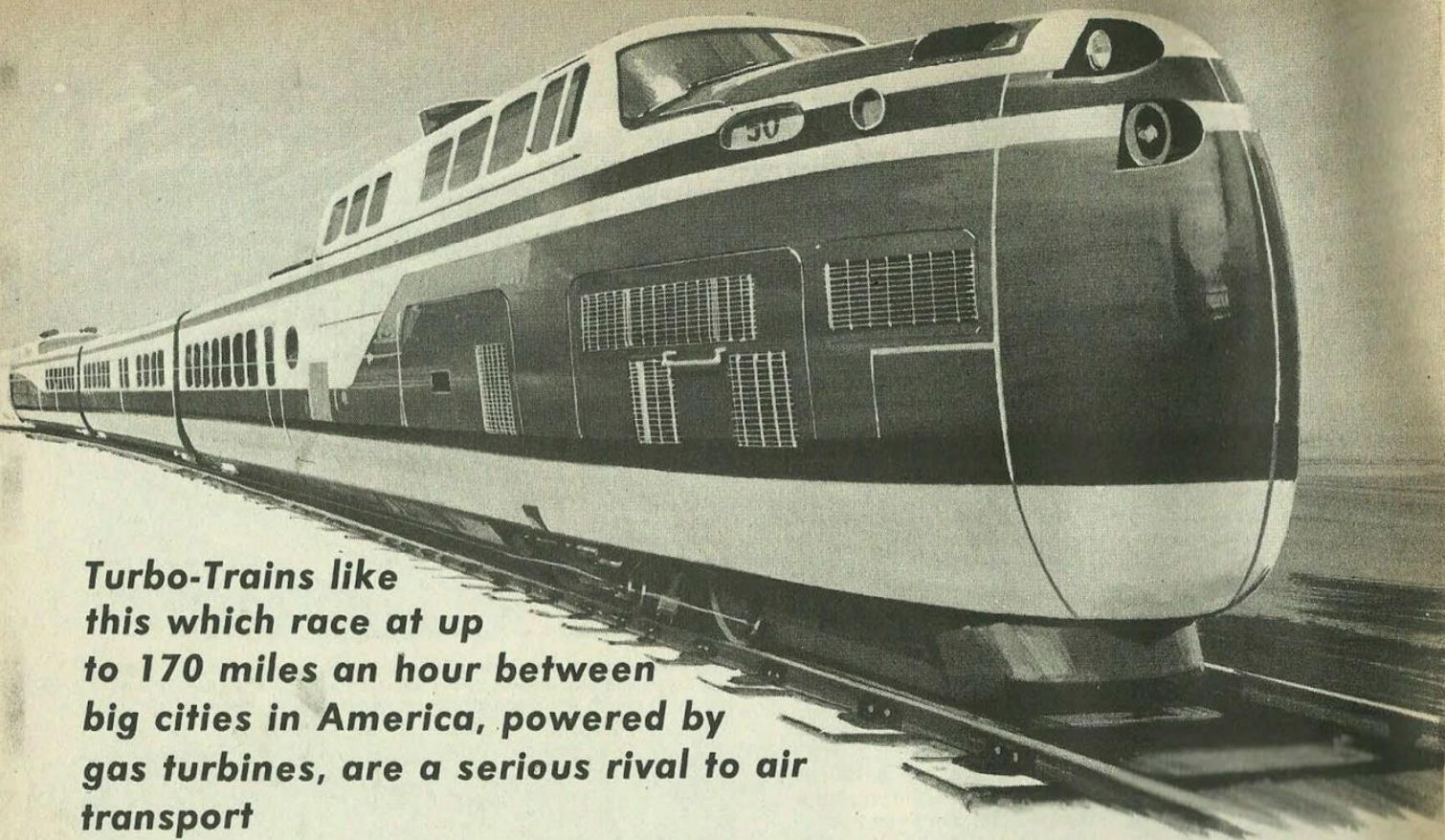


Above: a one-third scale model of a Japanese train which will float on magnetism and be propelled by the same force (linear induction). Below: a test rig in which the Japanese magnetic suspension system is being put through its paces.



A linear induction motor would propel this air cushion vehicle (like a hovertrain) between central London and the new London airport. It would be capable of carrying a hundred passengers at a cruising speed of 250 m.p.h.





Turbo-Trains like this which race at up to 170 miles an hour between big cities in America, powered by gas turbines, are a serious rival to air transport

looking towards a railway system without wheels.

They want to have high speed vehicles linking Tokyo and Osaka (320 miles apart) spinning along at between 310 and 370 m.p.h. and covering the distance between the two cities in sixty minutes.

This will be achieved by having a straight track geographically between the two cities, which will reduce the distance to 280 miles, over half of which will be through tunnels.

The vehicles will be guided and propelled by a linear induction motor and levitated magnetically.

There will be electro-magnets in liquid helium on the train and induction loop coils on the track. The primary side of the motor will be laid on the track, so that there will be an almost continuous motor winding all the way.

310 M.P.H.

Think of the cost of making this winding 280 miles long. It will be tremendous. But the Japanese say that it will pay for itself, with trains running every five minutes and carrying over one thousand passengers.

By November this year, the Japanese expect to have an experimental train of about one-third scale running on a 440 yard track. The things they have built so far are a

device to test magnetic lifting using super electro-magnetic coils, and an endless type linear motor for a speed of 310 m.p.h.

Their programme goes like this:

1972-74: testing assembled components.

1974-75: testing of prototype.

1976: start construction.

1980: commercial operation.

Now let us look at some other projects in the pipeline.

In the technological world, where initials are as plentiful as the flowers in May, they are called HSST — high speed surface transport. And their aim is to speed up inter-city travel, to take trade away from the airlines.

The trains we are familiar with may give way to mono-rails, tracked air cushion vehicles or the magnetic levitation system.

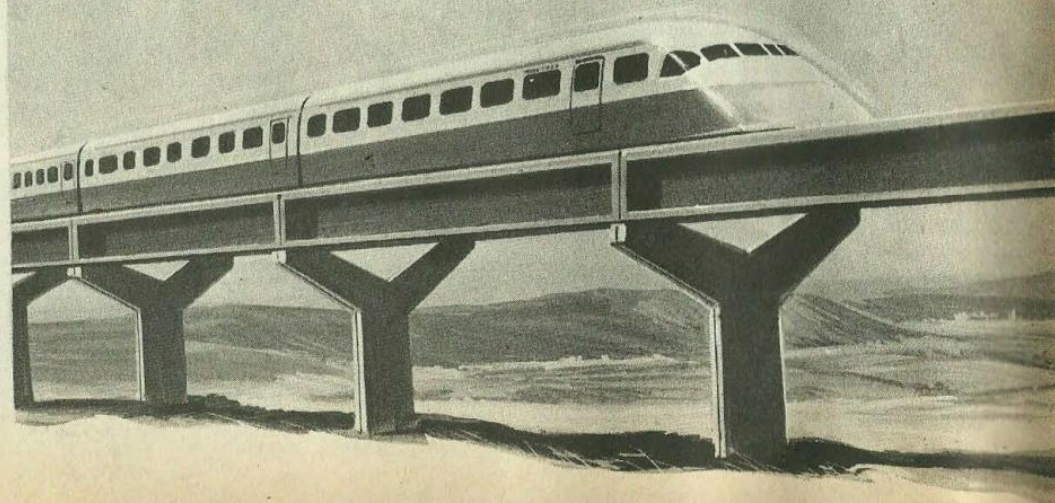
Another idea is the express bus which runs on a special track for part of the journey

and for the rest on special lanes on normal roads. This would really be used to provide a fast link with an airport or railway station.

High speed diesels eating up the miles at 125 m.p.h. should be whisking British passengers to their destinations late in 1973. Further in the future are the advanced passenger trains (described last week) which are planned to make their commercial trials in 1974.

But it may be in magnetic trains that the future lies.

Trains of the future may look like this German high-speed magnetic levitation vehicle, sketched from a model to illustrate experiments in Germany. The first prototype will, it is hoped, be ready in 1977.



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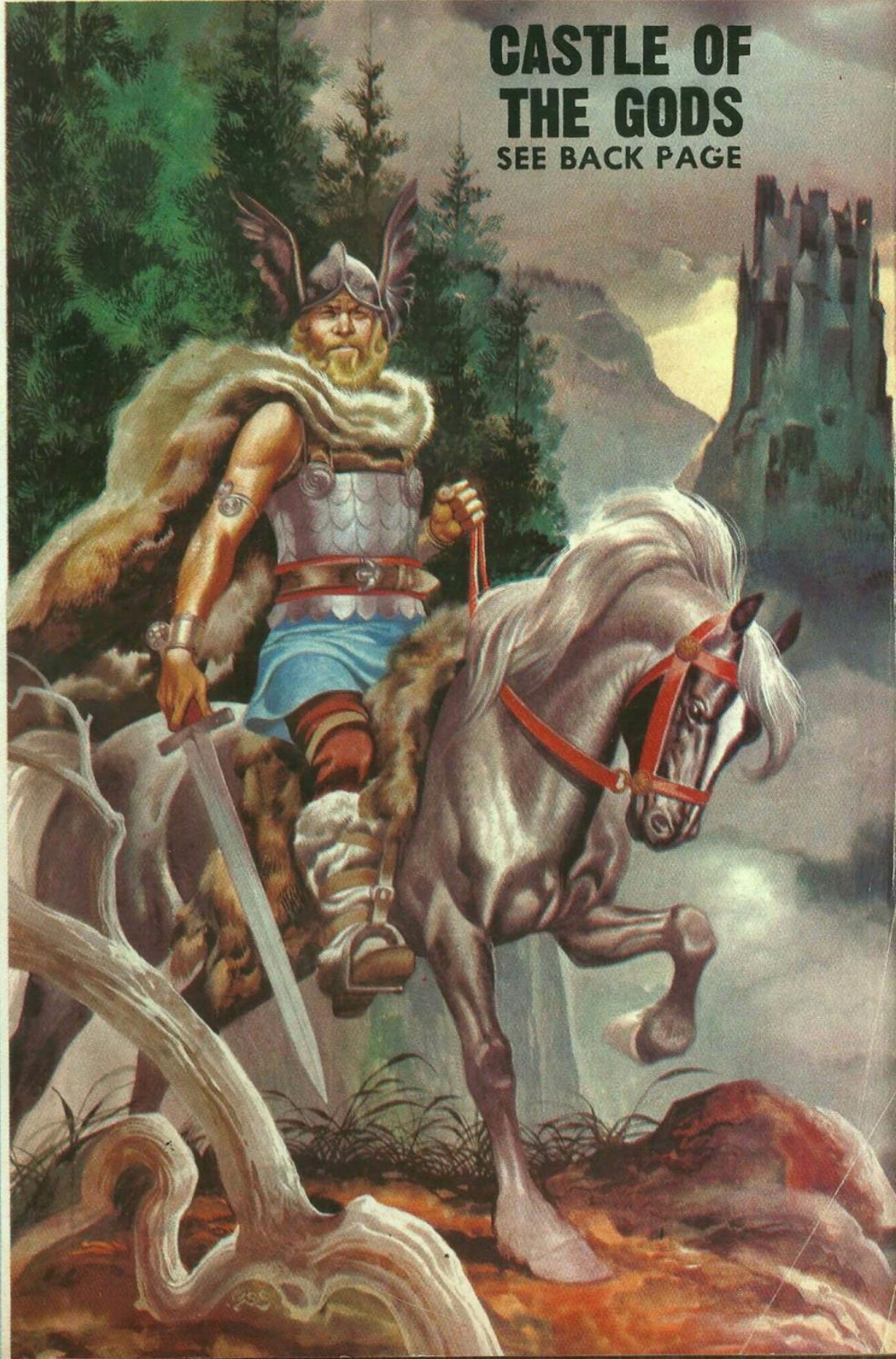
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**CASTLE OF
THE GODS**
SEE BACK PAGE



How Science Works - For YOU

JOHNNY is *thinking* as he does a school algebra problem: "Jim is twice as old as Bob was when Jim was as old as Bob is now. If Jim is 24 years old now, how old is Bob now?"

Thirty miles away in a London university two research scientists are waiting for an electronic computer to solve the same problem. The problem has been *programmed* into the computer using a long strip of paper punched with holes in the form of a code.

Less than a second later the correct answer is automatically typed on another strip of paper by a special machine connected to the computer's control panel by an electric cable.

Twelve *minutes* later Johnny scribbles down *his* correct answer.

Johnny and the computer have both solved the problem in the same way, using two basic steps. In step one the letter "x" was used to represent Bob's age. In step two the value of "x" was calculated by solving an equation.

Johnny might have been most intrigued if he had known what had been going on in London, and he would probably have done some more careful thinking and asked himself a few questions:

COMPUTER CODE

"I have solved this problem using my brain. That machine in London has used its electronic "brain" to solve it. It took me about twelve minutes to find the correct answer, yet a machine was able to find the answer in less than a second. Can this machine *think*? If so, why have I got to waste my time doing algebra, when we can build machines which can solve all our problems for us?"

He might still be thinking and wondering and being puzzled later on on his way home from school. He might even wonder why they wasted a man's valuable time driving the bus, when a machine could do an even better job?

The computer which could solve an algebra problem is about the size of a large piano and contains many thousands of electronic parts and some hundreds of miles of wiring.

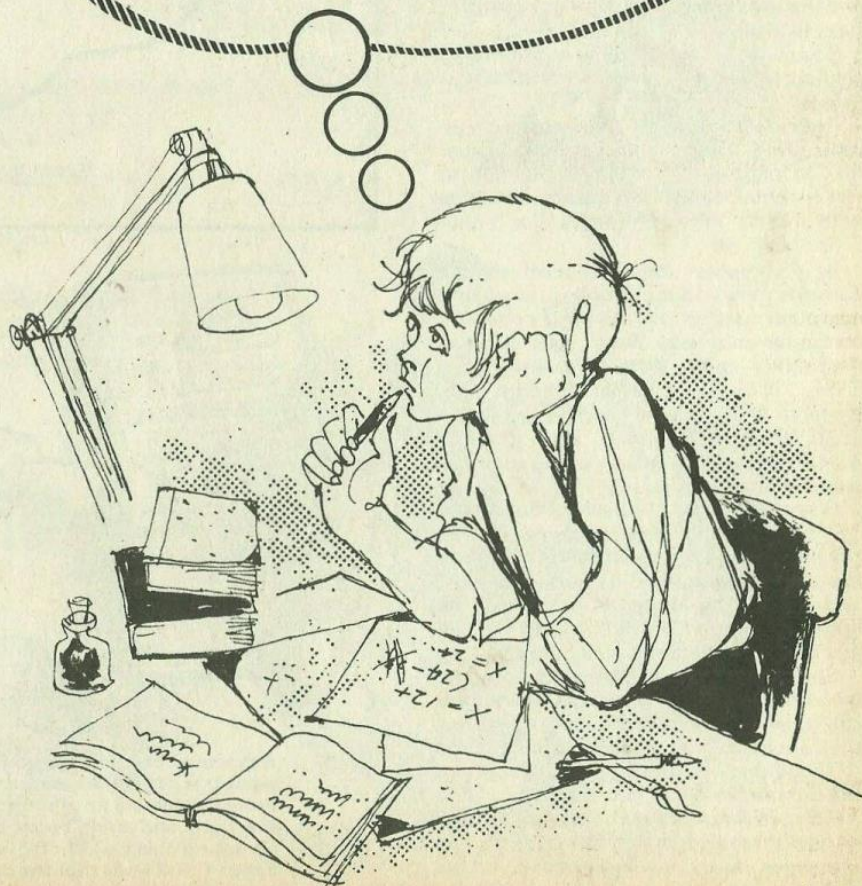
The "computer" inside Johnny's head, however, is quite different. It is not much bigger than a grapefruit and contains not thousands but many thousand-millions of "parts" in the form of tiny nerve cells.

There are more important differences between a human brain and an electronic "brain," however.

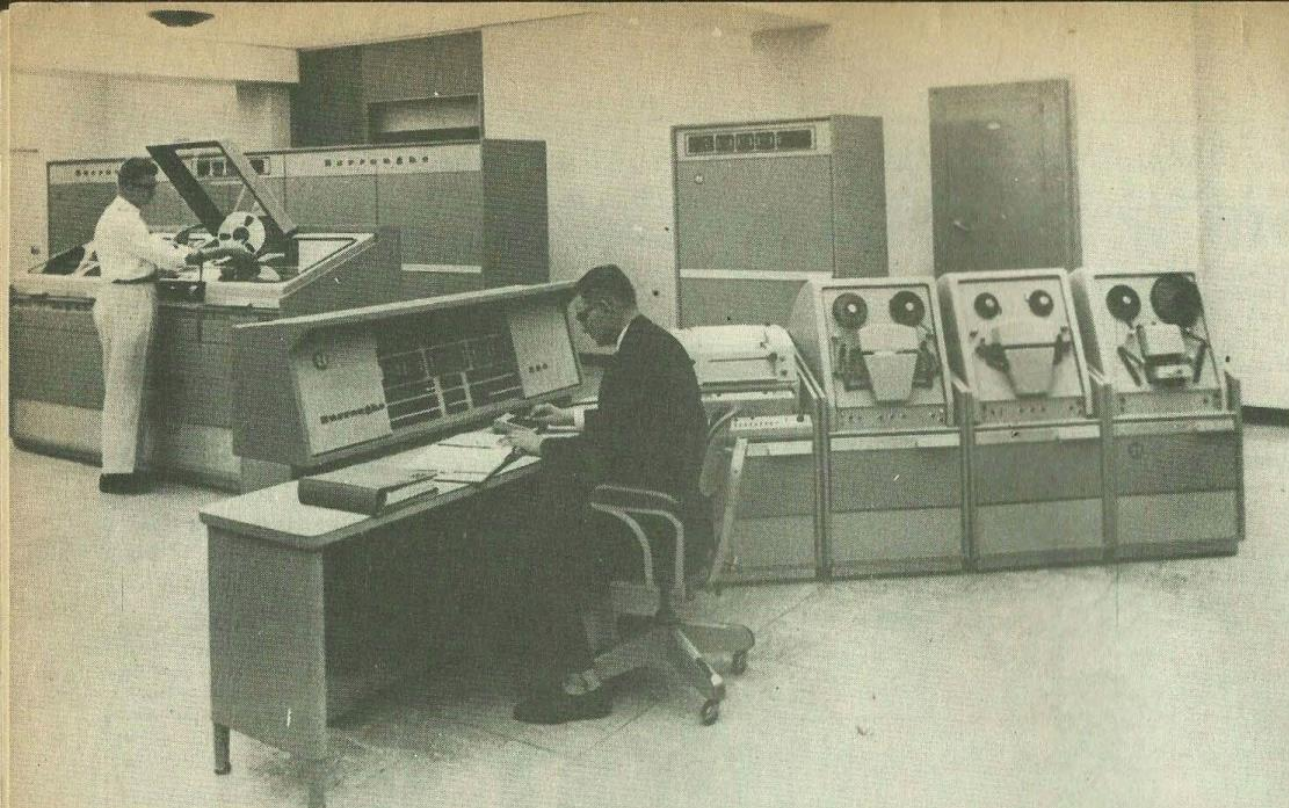
A computer must be told *what* to do and *how* to do it. It must be *programmed*. The problems to be solved must be carefully studied by human beings, who then give the computer its instructions in the form of a *code*. This coding can be simply a series of holes punched in paper, or tiny particles of magnetized iron on plastic tape. Some

Although a modern electronic computer can solve problems a million times faster than the human brain, it can only do what it has been "told" to do by the people who programme it. In this sense computers cannot "think." But what is "thought"? Today many amazing electronic machines can do things that people cannot do at all. Can we say that they "think"? To answer this question scientists and engineers must know much more about how the human brain works when we "think"

WHAT IS THOUGHT?



CONTINUED ON NEXT PAGE



A high-speed banking system using computers to do the work of many clerks in minutes instead of days and weeks.

This diagram of the human brain shows the shaded areas responsible for some familiar actions. The dotted part is the hypothalamus, which scientists believe controls human emotion.

computers can be programmed by simply turning switches on and off.

Although a computer can solve a complicated problem in a fraction of a second, the programming can take several hours.

The human brain, however, programmes itself, in effect. The eyes read the problem from a sheet of paper, and nerve messages flow directly into the brain through two optic nerves. Each optic nerve contains more nerve fibres than most computers contain electronic parts, and the eyes and their nerves should really be considered part of the brain.

Scientists have discovered a fascinating similarity between computers and human brains.

Both do their jobs using electric currents. And these electric currents either flow at full strength, or they do not flow at all. In other words the various parts of both brains and computers are either "on" or "off."

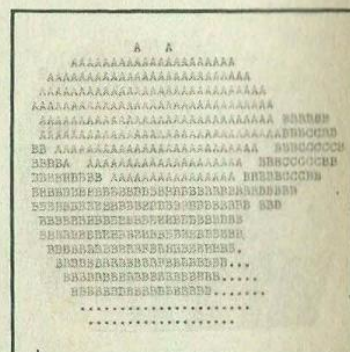
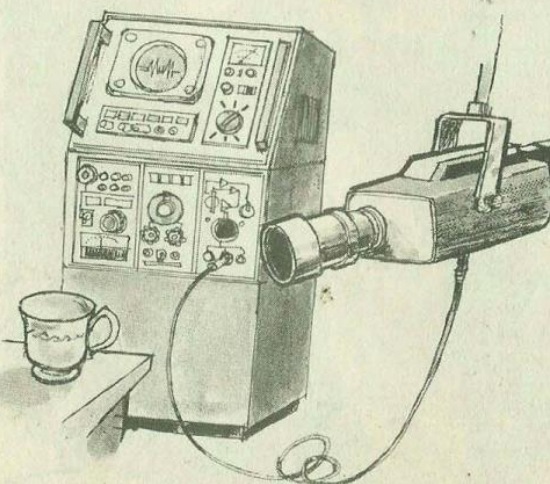
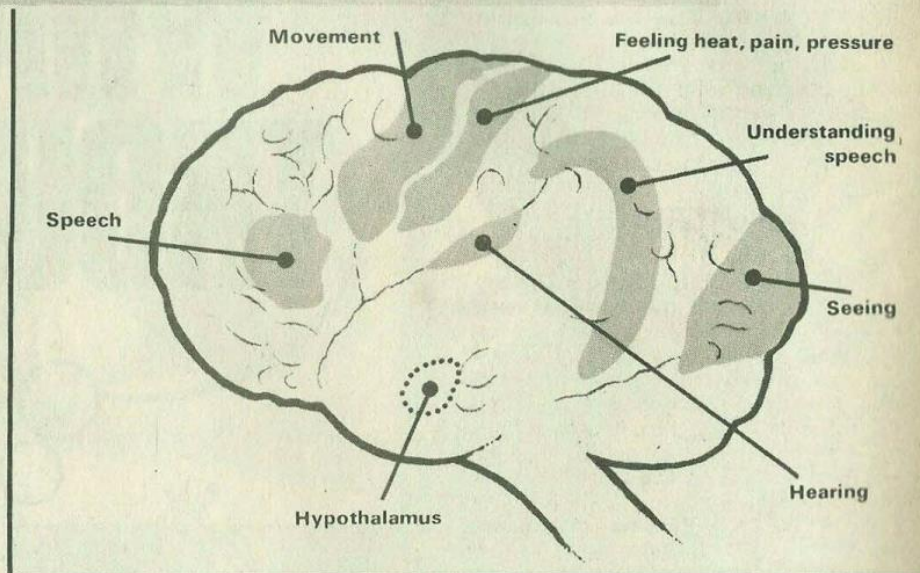
In a computer these on-or-off electric currents make up the "code" used in a computer, called the *binary code* by computer engineers. Brain cells also use the binary code. When a brain cell is "on" it is said to be "firing" by research doctors who study the human brain. When a cell is not "on" it is in a *quiescent state* and is getting ready to start "firing" again.

Does a computer "think"? Because it can solve complicated problems we can say that it does. But because the computer has to be programmed by human beings, and has to be designed and built by human beings in the first place, we can just as safely say that it cannot think.

Some computer engineers, who know the computers they work with inside out, call them "electronic idiots" because they are really only helping humans think!

Today doctors know a great deal about the human brain and how it works.

The brain sends out messages through nerves to every part of the body. Some messages make our limbs move, others make our tongues start talking and our



A machine can be used to "look" at an object and recognise it and say what it is. This TV camera examines the cup for a fraction of a second. From the camera an electric current works the computer, which "codes" the light and dark areas of the cup into letters. The computer then compares this coded diagram with various codes stored in its "memory banks" and finds that the diagram obviously matches its "memory" of a cup!

fingers pick up pencils and start writing. Other messages flow into the brain, telling us that a tooth is aching, a foot is being squeezed by a too-tight shoe, or that the sun has set. And doctors know exactly which areas of the brain contain the nerve cells which send out and receive these messages.

We have even discovered a mysterious part of the brain, hidden deep in its centre, where our emotions are controlled. Called the *hypothalamus*, this strange collection of cells can send out messages which make us angry, or sad, or frightened. The hypothalamus, it is also believed, can also make us lazy, make us love somebody, or write a romantic poem!

Yet strangely enough, doctors still know very little about how the brain actually *thinks*. What kinds of messages are sent around inside the brain when we are solving algebra problems, designing bridges, radio sets, and computers? What

exactly happens when an artist paints a picture, or a pop musician becomes inspired and gets a new "sound" from his electric guitar?

We do know that the brain, like a computer, must be programmed so that we can think. In effect, our teachers programme our brains so that we can solve problems. Our parents "programme" our brains so that we can tie shoelaces and use pedestrian crossings. And for the whole of our lives we are being programmed by new experiences, by visiting foreign countries, by listening to new music, by being trained to do new jobs.

Although scientists can test intelligence they are not very sure what "intelligence" actually is. All they are certain of is that *intelligence* is an ability to do many kinds of work, many kinds of thinking.

The more the human brain is studied,

the more mysteries it seems to reveal. Why is it that the brain itself cannot feel pain? Why is it that some very intelligent scientists cannot recognise one tune from another? Why is it that the brain can remember some facts for years, yet forget other facts in a few days? Why is it that many brilliant mathematicians simply cannot play chess?

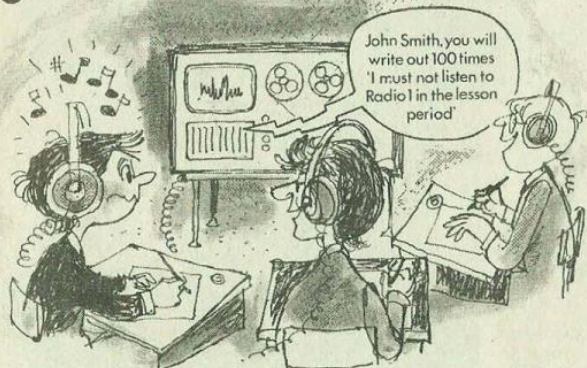
For that matter, how much *original* thinking do we really do? Perhaps when we believe we have solved a problem the brain is simply repeating itself, doing the same job it did a long time ago!

SOLUTION TO PROBLEM IN TEXT:—

Let x equal Bob's age now. When Jim was X years old Bob was 12 years (half Jim's age now) and that was $24 - x$ years ago. Therefore $24 - x$ years ago Bob's age could also be $12 + (24 - x)$

$$\begin{aligned} \text{or } -x + x &= 12 + 24 \\ \text{or } 2x &= 36 \\ x &= 18 \end{aligned}$$

1975



Although we can think, we are using more and more machines to do our "thinking" for us. Here are some predictions about the future:

1975

Most schools will use teaching machines

1985

Most homes will use walking robots

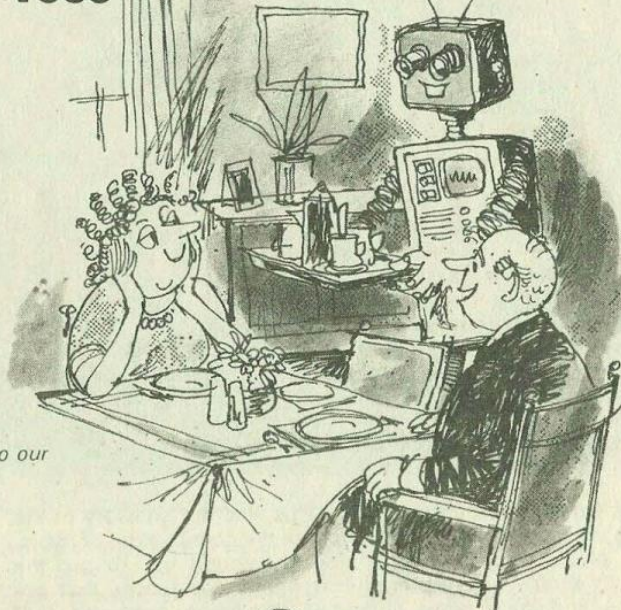
1995

Most cars on the roads will use robot drivers

2000

Home TV sets will print our morning papers

1985



1995



2000





Modern Marvels

The Piggy-Back Space Ship

The delta-winged space craft lifts off the launch pad. Less than two minutes later it powers itself into an orbit a hundred miles or more out in space. Futuristic? Yes, but a practical possibility.

CAN you imagine a space craft which takes a piggy-back style ride into space on the back of a rocket, and then flies back to earth to land like an aeroplane?

It sounds incredible, but it may not be long before you are watching craft like this on television, for America plans to be using them before the end of the 1970s.

Ordinary space flights, in which rockets taller than Nelson's column in London, are thrown away in space after their power is used up, cost millions of dollars.

Nobody can afford to go on spending money at such a rate. So, the Americans have been working on a much cheaper idea, called a space shuttle.

Basically, this consists of a manned orbiter, which will be the world's first space aeroplane. It will have a ride into space on the back of a solid-fuel booster.

Later on, it will have the help of a space tug, a small, un-manned engine which can be parked in orbit and used as a tug or shunting engine, controlled from the ground.

Apart from the pilot and co-pilot, the people who will be flown into space by the shuttle need not be trained astronauts. They can be scientists, doctors or laboratory technicians, who could be taken to work in space without the need of special flight training.

If a space laboratory is put into orbit, the shuttle could be used to ferry crews to and from the space lab.

The core of the space shuttle idea is the

delta-wing orbiter, 120 feet long and with a 70 feet wing span. It is roughly the size of a modern airliner like a Boeing 707 or the BAC 1-11. Nearly all of America's future satellites could be carried into orbit by it, as well as their service and repair facilities.

Short-term space jobs could also be carried out by the orbiter, while it is between one hundred and 260 nautical miles above the earth. This distance will be reached in about ten minutes, and it will be able to carry a load of 65,000

CONTINUED ON NEXT PAGE

In this sequence of pictures, you can see how the space shuttle is launched.

1. Lift-off from all main engines. The shuttle's engines are fed from the big main fuel tank to which it is attached.
2. Solid-fuel boosters burn out and separate, to be recovered by parachute.
3. The shuttle's fuel tank separates, and is brought back to earth by parachute.
4. The shuttle is at work, its manipulating arms extended. The cargo doors are open, and a space tug has been launched. You can read about this in the article.
5. The shuttle re-enters the atmosphere.
6. Landing on a normal runway. It will land as an unpowered aeroplane, gliding in at high speed with excellent control. On some missions, jet engines will be carried, these being stowed in the rear of the cargo bay and swung out for use in landing. After two weeks' inspection and servicing, the shuttle can be used again.



4



5



6

pounds and stay in orbit for 30 days.

Attached to each orbiter at the launching will be an external tank carrying the liquid fuel for the plane's three rocket engines. This tank will be cast away in orbit, and the only fuel carried inside the orbiter will be a small amount for manoeuvring and re-entry.

To help boost the orbiter into space, solid propellants will be used for the first time in America's manned space programme. They will be used in two auxiliary boosters strapped to the side of the orbiter. All five motors will fire together at blast-off.

Apart from the pilot and co-pilot, already mentioned, the crew will include two engineers who will operate the cargo bay hatches and cargo-unloading in space.

These men will work in their shirt-sleeves (no space suits needed) in a controlled atmosphere. Behind them will be a cavernous bay, which may be occupied by almost anything needed in space — a small satellite, fuel and supplies for space stations, the space tug, parts for building a space station, or passengers.

It is very useful to be able to take into space people who have not had to spend time training as astronauts. It will enable scientists and other experts to accompany their experiments into space, and to see how they are progressing.

A typical orbiter mission may last from a week to thirty days. Once it is completed, the vehicle will be piloted into the earth's upper atmosphere, manoeuvring as a space craft until it reaches an altitude of about 400,000 feet.

At that point, its wings and other aerodynamic surfaces take over for a flight towards the ground and a landing on an aircraft runway.

After servicing, it will be ready for another flight in about a fortnight. This is its key feature, and it is being designed to fly up to a hundred times in ten years without any major parts being replaced.

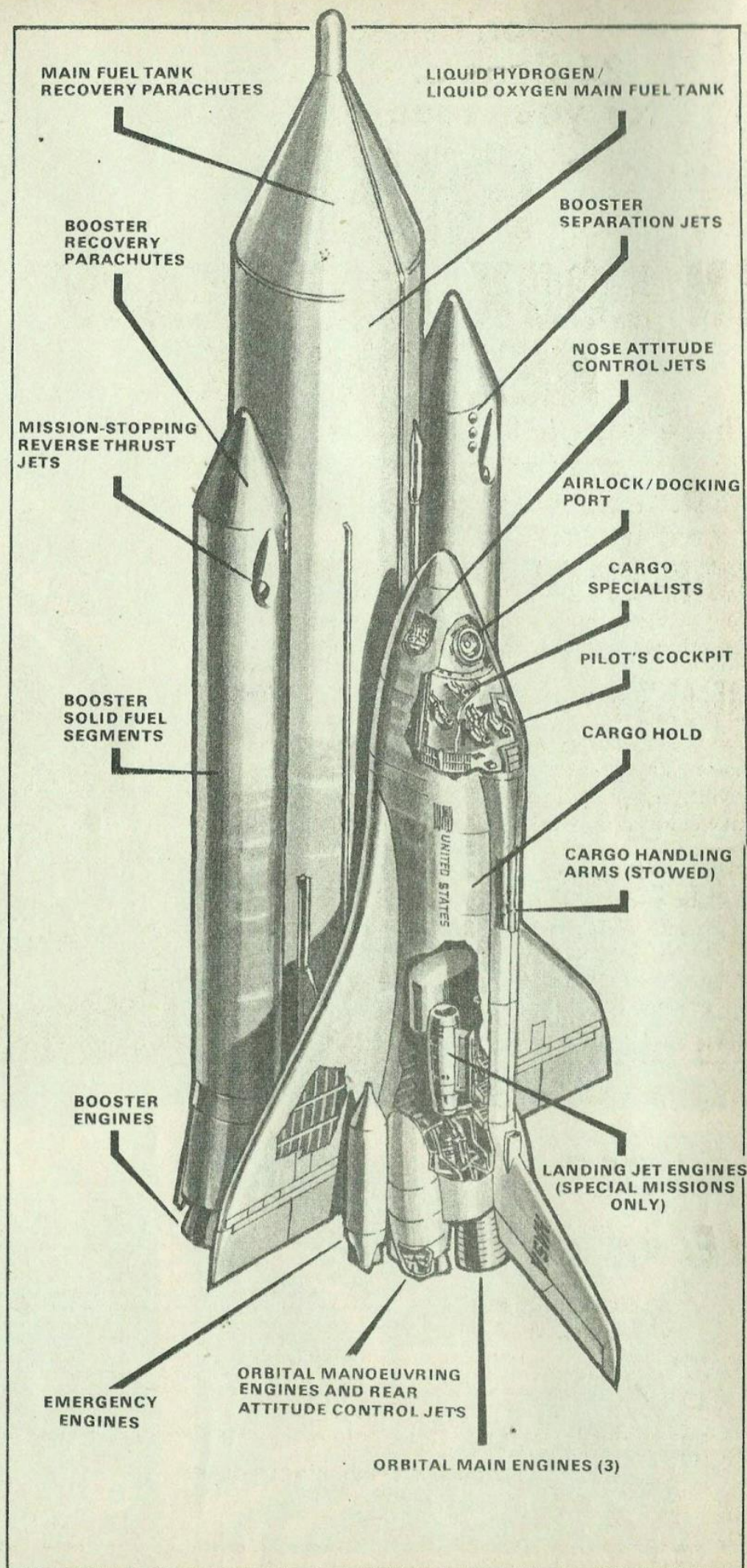
The cost of developing the shuttle system will be a quarter of that of the Apollo programme, and it will be cheaper to launch than any other space vehicle of the same size.

The big saving, however, will come in the cost of the scientific cargo ferried backwards and forwards, instead of being lost in space forever as with ordinary space flights.

This cheapness may encourage more countries to take an interest in space research which could benefit men on earth. It will place new satellites into orbit that can help us study and manage the earth's resources. Others will give us far better weather information. And it will take men and equipment to space laboratories working in an absolutely pure atmosphere where scientific and medical research can be carried out.

Do you remember the unlucky Apollo flight in which an over-heated oxygen tank exploded and burst a hole in the space ship's side. With great difficulty, the crew were brought back to earth.

But they could have been stranded in space. The shuttle if it existed then, could have gone into space to repair that damaged Apollo or bring the men back to Earth.



THE DEFENDERS

The Story of Fortification

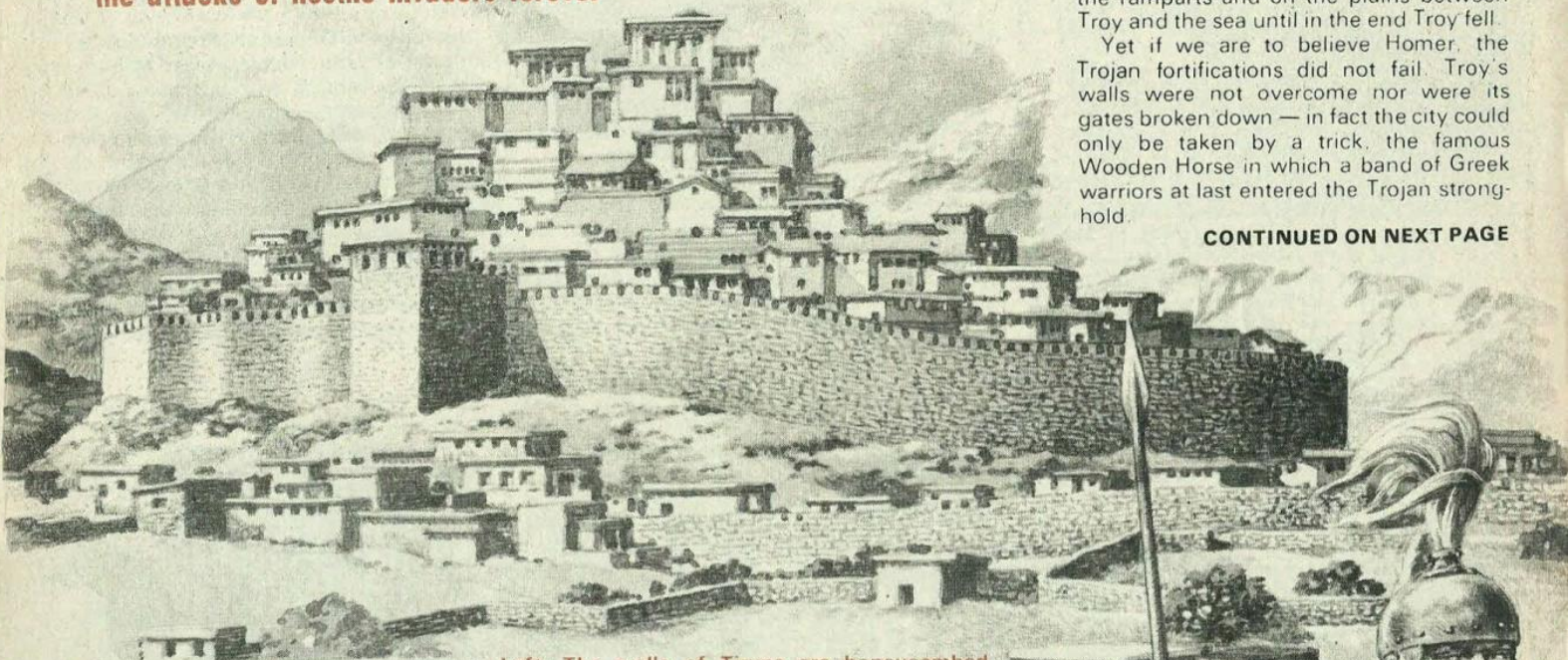
Battles of the Bronze Age

The mighty and magnificent citadels of Mycenae and Tiryns were superb examples of military architecture, but even they could not withstand the attacks of hostile invaders forever

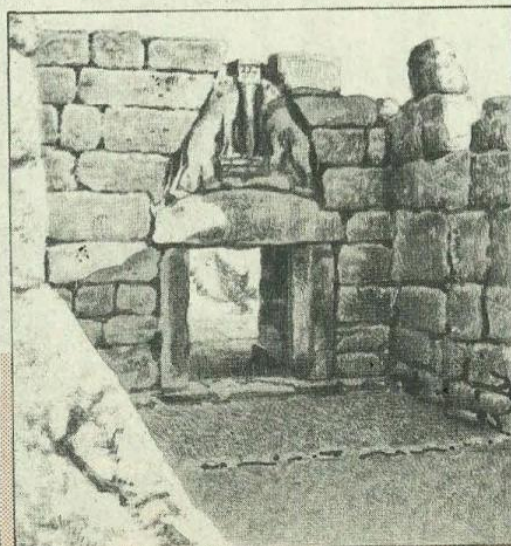
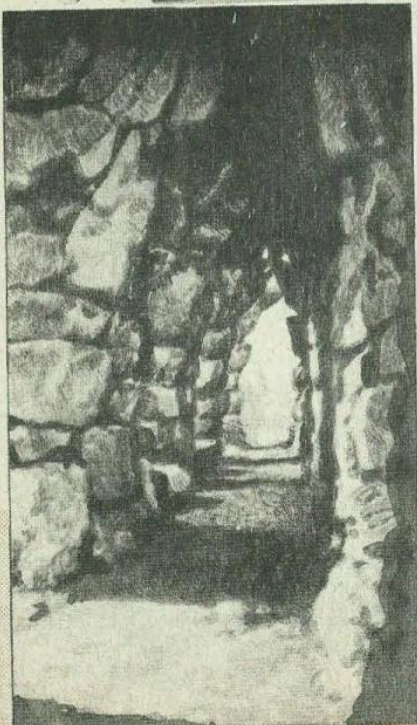
FOR month after month the mighty walls of Troy stood firm against the invading Greeks. Homer, the ancient historian, describes battles beneath the ramparts and on the plains between Troy and the sea until in the end Troy fell.

Yet if we are to believe Homer, the Trojan fortifications did not fail. Troy's walls were not overcome nor were its gates broken down — in fact the city could only be taken by a trick, the famous Wooden Horse in which a band of Greek warriors at last entered the Trojan stronghold.

CONTINUED ON NEXT PAGE



Left: The walls of Tiryns are honeycombed with mysterious galleries which could have been dungeons. The magnificent Lion Gate of Mycenae (below) has two lions which stand guard over the gateway like huge heraldic emblems.



The great Bronze Age fortress of Mycenae was the home of Agamemnon, the warrior king who led the attack on Troy. The walls of Mycenae were built of vast stones which people later believed were built by giants called the Cyclops.

The brilliant minds of Athens designed superb fortifications for their city

Is it only a story? Perhaps the Wooden Horse never existed but Troy certainly did and it had some of the toughest fortifications of its day. These walls have been discovered beneath the bleak hill of Hissarlik which is all that now remains of once proud Troy. Hissarlik overlooks the Dardanelles in Turkey, the frontier between Europe and Asia, and for over a thousand years Troy was like a bridge between the two continents. Nine cities were built at Troy, one above the other. Troy's position made the city wealthy by trade but also put it in the path of every passing army. Each of those nine cities was destroyed by conquest or earthquake, but it is the sixth Troy that most archaeologists believe to be the city besieged in Homer's epic tale.

Its walls were built like panels, each flat and slightly angled one to the other so that there were no curved surfaces anywhere. Troy also had a recessed gateway built between the main wall and an overlapping stretch of ramparts so that anyone attacking the gate could be shot at from both sides. This was a new and clever idea.

The army that eventually destroyed this sixth Troy in around 1,300 BC, came from the Greek mainland, from citadels like Mycenae and Tiryns. Both these towns were masterpieces of Bronze Age military architecture. Homer named them "My-

cenae rich in Gold" and "Tiryns of the Great Walls," and both were built of huge blocks of uncemented stone. The folk of later years thought that they must have been built by giants called the Cyclops and even today such walls of great rough stones are known as Cyclopean Walls.

SEA POWER

Science as well as size made these Bronze Age citadels safe. The steep path leading up to the main gate of Tiryns runs right along the foot of the ramparts so that any attacker had his right side towards the defenders. This was very important. Shields were always carried on the left arm leaving the right side wide open for any arrows coming down from the walls above.

Not far from Tiryns is Mycenae with its famous Lion Gate. Here a great king had wanted to impress his visitors and he certainly must have succeeded. Two lions stand guard over the gateway like huge heraldic emblems. Their heads are gone, but decapitated as they are, these lions of Mycenae, the oldest monumental sculpture in Europe, are still very impressive. There were once wooden gates beneath the lions and we know how they worked from descriptions written by Homer. The gates rested on bronze pivots and were

secured with a sliding bar. To be on the safe side they were also tied shut with a great thong.

Though magnificent, these citadels were not impregnable. Mycenae and Tiryns eventually fell in about 1275 BC to new invaders called the Dorians. In fact the last desperate defenders of Tiryns still lay beneath burnt debris at the base of their defences when archaeologists excavated the city less than a hundred years ago.

Athens had a citadel very similar to Tiryns but unlike Tiryns it was soon reoccupied and grew to be the centre of one of the world's noblest cities. We now call this ancient citadel the Acropolis which means "high city." Its ancient walls still stand, though it is the more peaceful grandeur of the Parthenon within the fortifications that tourists flock to see. Even the Golden Age of Classical Greece, many hundreds of years after the fall of Troy, Mycenae and Tiryns, was a time of violence and not surprisingly the brilliant minds of Athens designed superb fortifications for their city.

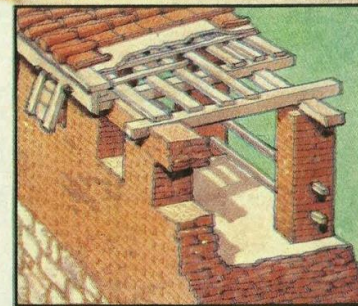
They had good reason. The Persians devastated Athens in 480 BC and as soon as the invaders were defeated, Themistocles of Athens set about improving the city's defences. A great wall, wide enough for two loaded waggons to pass



When the Athenians attacked Boeotia they built a wooden fortress as a base, but the Boeotians replied with a new weapon — the flame-thrower.

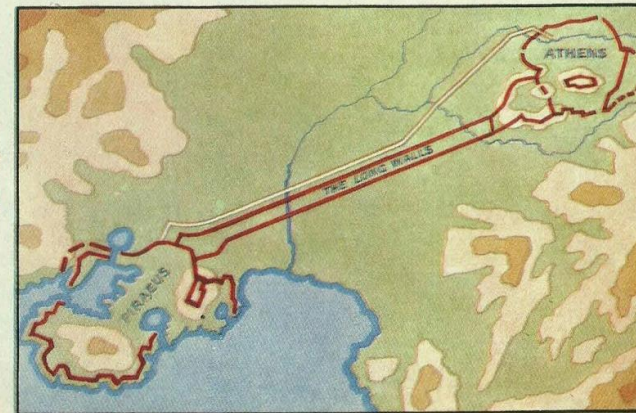
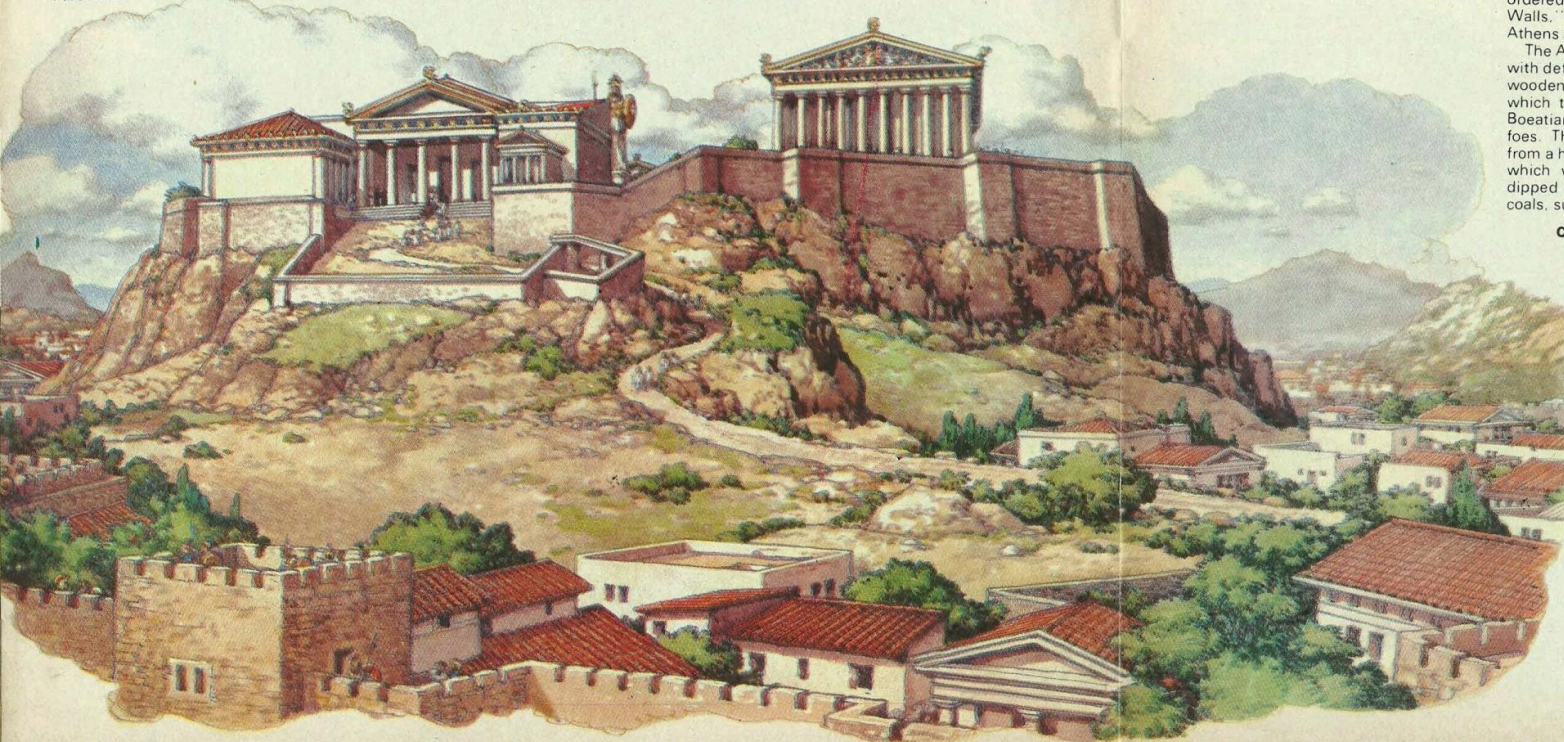
on its summit, was erected all around Athens, but Athens was a sea-power and her true strength lay with her fleet down in Piraeus harbour over four miles away. Some years later the new Athenian leader, Pericles, decided to make sure that Athens was never parted from her fleet. He ordered the building of the huge "Long Walls," parallel fortifications that linked Athens and Piraeus.

The Athenians were not only concerned with defence. On one occasion they built a wooden fortress as a base camp from which to attack nearby Boeotia, but the Boeotians were just as inventive as their foes. They made the first flame-thrower from a hollowed out tree trunk, one end of which was plated with iron. This was dipped into a huge cauldron of burning coals, sulphur and pitch. At the other end



Above: A section through the ramparts of Pericles' Long Walls which linked Athens with Piraeus. Below: the Long Walls ensured that Athens was never separated from its powerful fleet down in Piraeus harbour.

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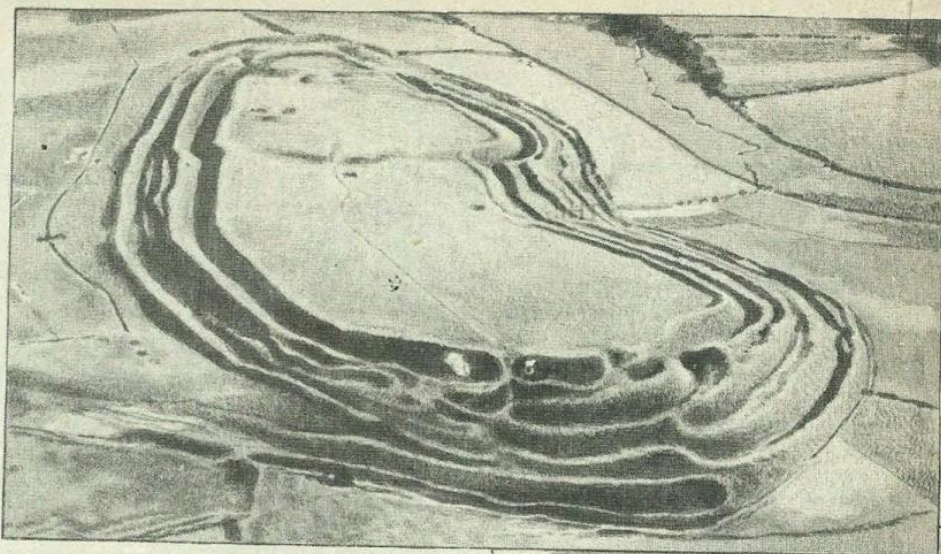


The heroic age of wooden forts and Celtic barbarism finally gave way to the organised world of Rome

were gigantic bellows. When these were pumped a jet of flame was blasted against the wooden Athenian fort, completely destroying its walls.

Fortunately the Celts of prehistoric Europe never came up against the Boeotians for almost all of their hill-top towns were built of wood. The most famous Celtic fortified town is Maiden Castle in Dorset. Most of what can be seen today was built by Iron Age Celtic tribes shortly before the Romans conquered Britain, by which time the Celts had learned to build ramparts of stone as well as wood. The sling was the Celts' great weapon and it forced Celtic fortress builders to construct concentric circles with multiple ditches, ramparts and palisades. Stone platforms from which the slingers could hurl their stones were built into the complicated defences of Maiden Castle. So were storage pits full of spare stones for the slingers. But slings were little use against the heavily armoured legions of Rome!

In either 43 or 44 AD the 2nd Augustan Legion commanded by Vespasian advanced into Dorset. They had a tough fight for Maiden Castle. After bombarding the ramparts with heavy ballista-arrows, one

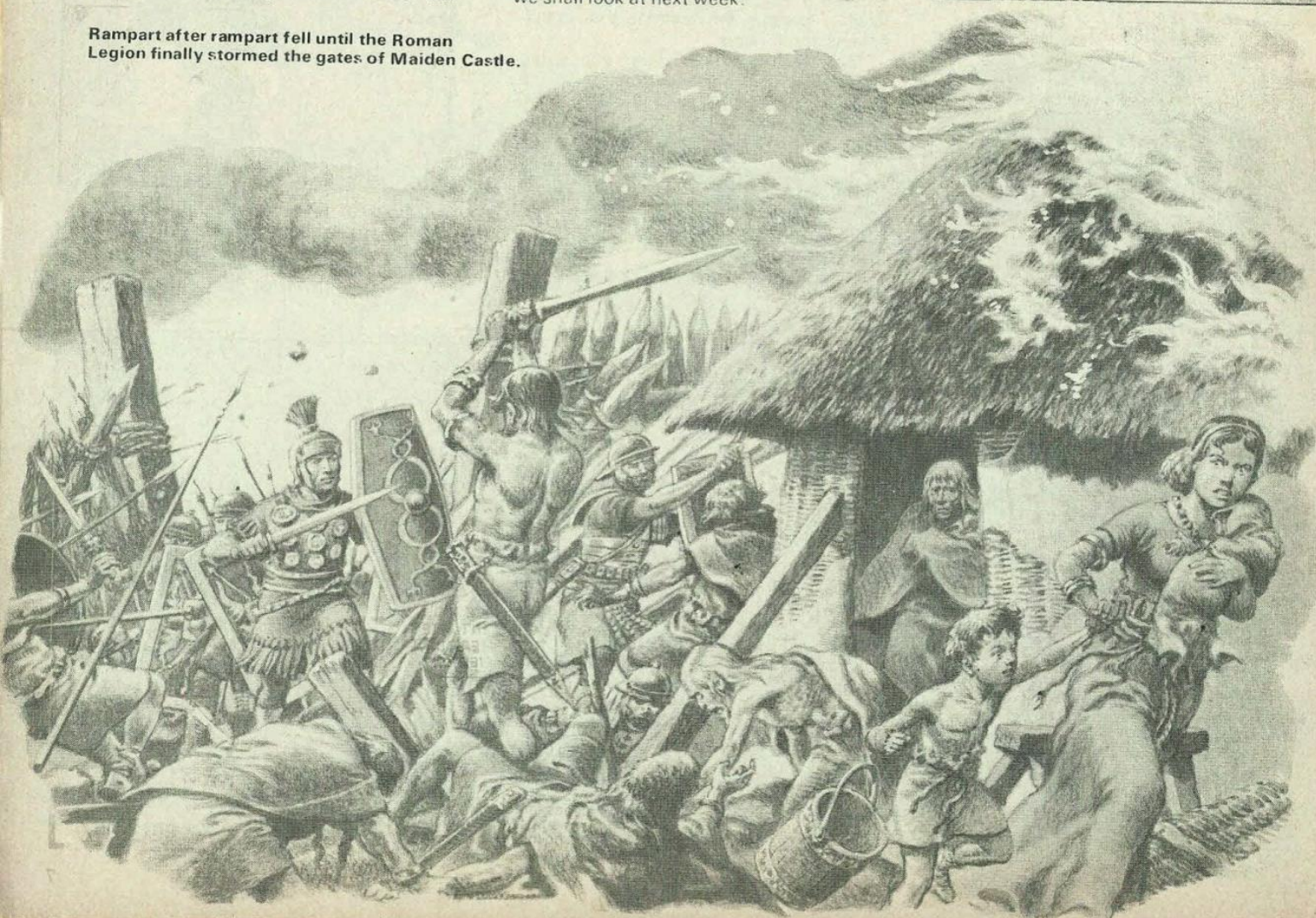


Above: The multiple ramparts and ditches of Maiden Castle in Dorset are best seen from the air. **Right:** an effective wall around many Celtic fortresses was made up of a wooden palisade on top of an earthen rampart.



of which was found forty years ago still embedded in the skeleton of a British defender, the Romans advanced. Rampart after rampart fell until at last the Legion stormed the gates of Maiden Castle. The battle was over and the heroic age of wooden forts and Celtic barbarism finally gave way to the highly organised and well defended world of Rome which we shall look at next week.

Rampart after rampart fell until the Roman Legion finally stormed the gates of Maiden Castle.



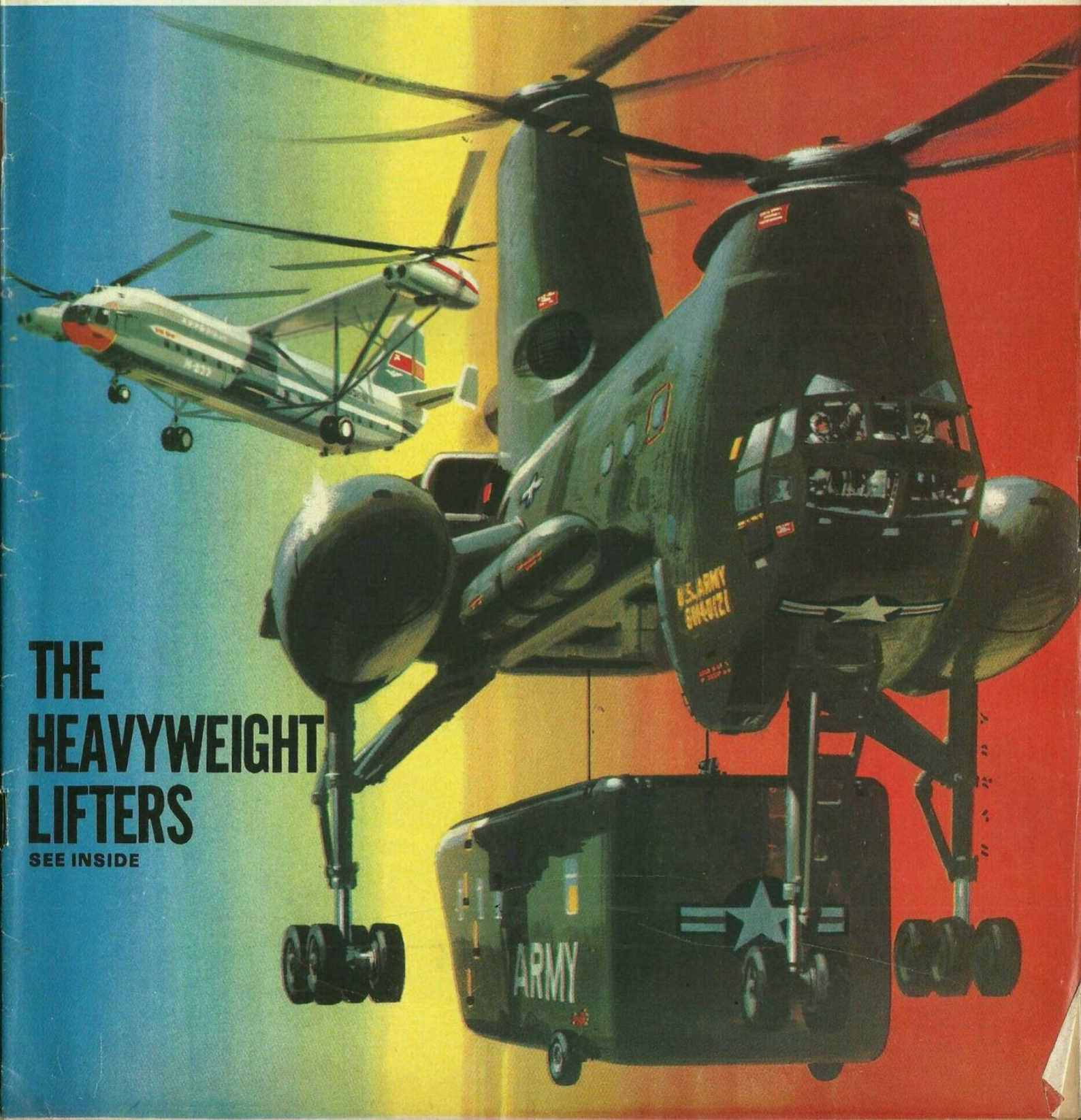
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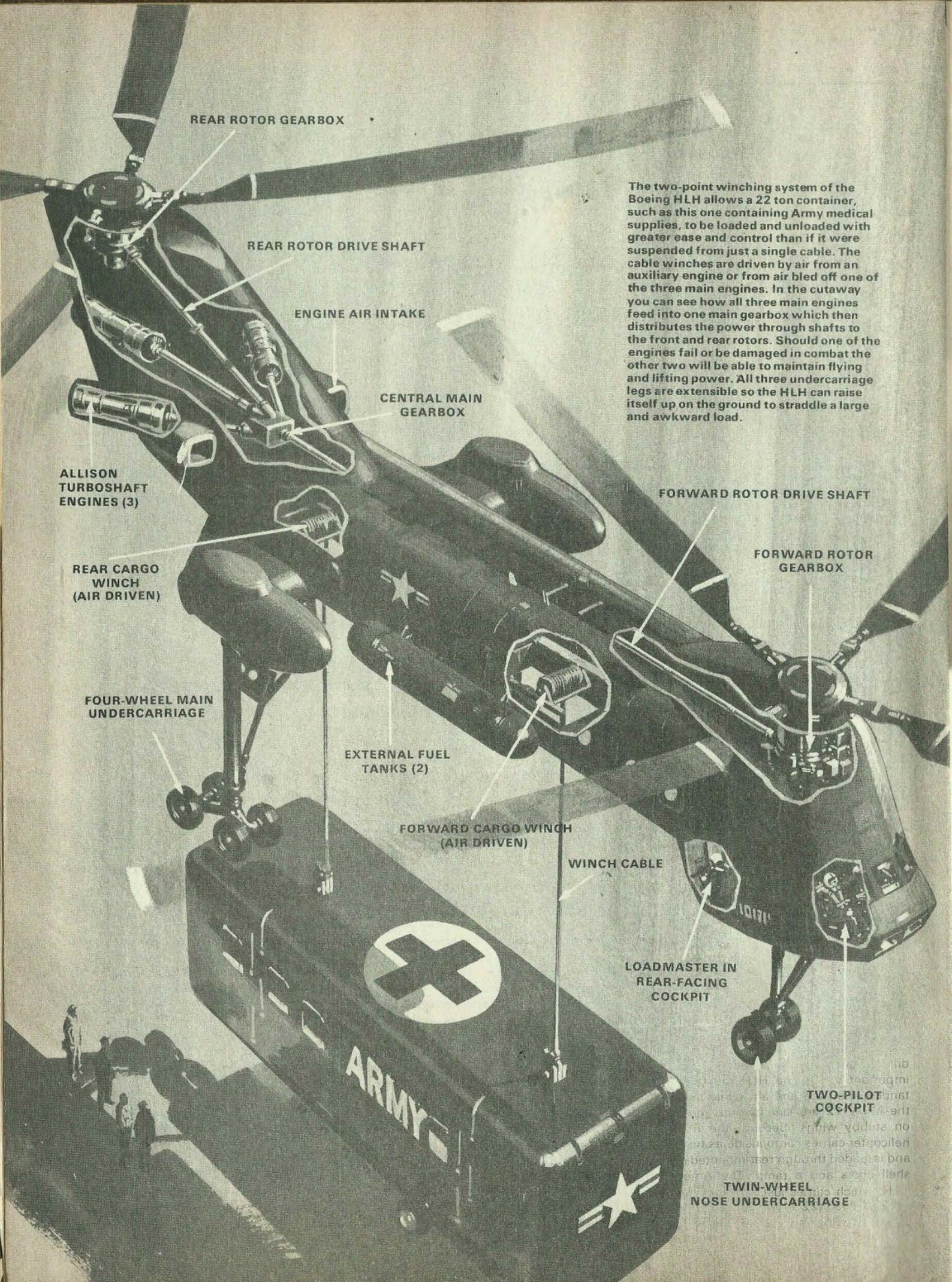
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ALLISON TURBOSHAFT ENGINES (3)

REAR CARGO WINCH (AIR DRIVEN)

FOUR-WHEEL MAIN UNDERCARRIAGE

EXTERNAL FUEL TANKS (2)

FORWARD CARGO WINCH (AIR DRIVEN)

WINCH CABLE

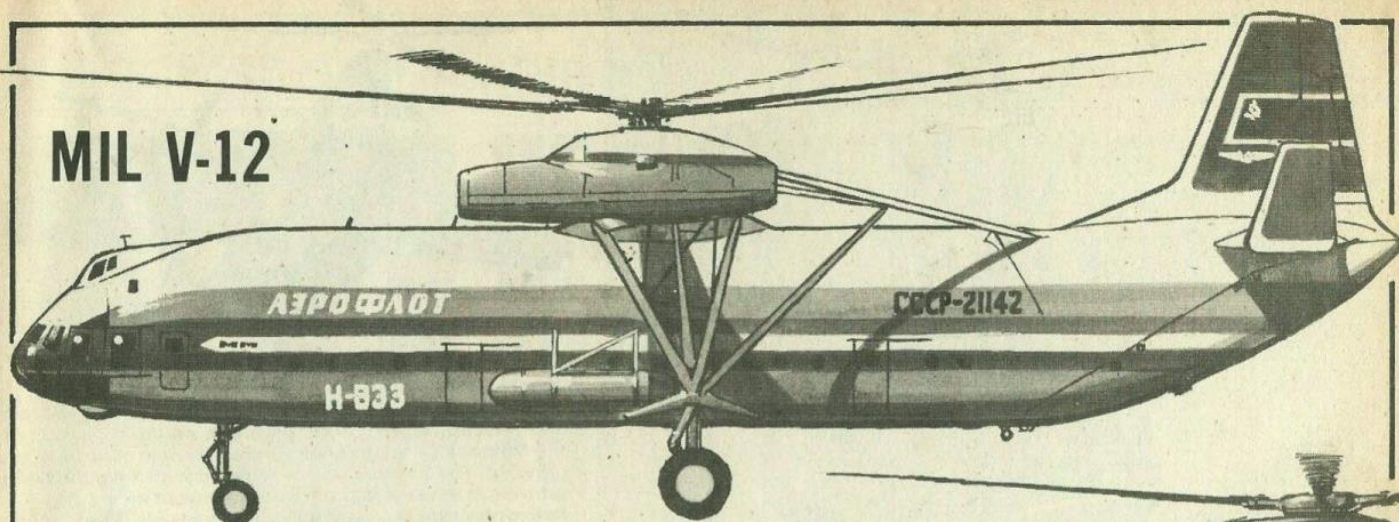
LOADMASTER IN REAR-FACING COCKPIT

TWO-PILOT COCKPIT

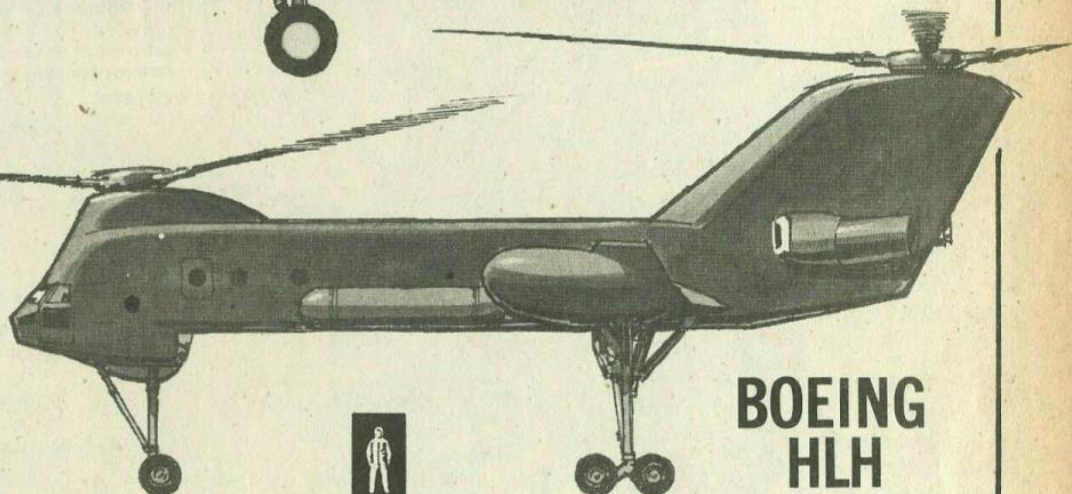
TWIN-WHEEL NOSE UNDERCARRIAGE

The two-point winching system of the Boeing HLH allows a 22 ton container, such as this one containing Army medical supplies, to be loaded and unloaded with greater ease and control than if it were suspended from just a single cable. The cable winches are driven by air from an auxiliary engine or from air bled off one of the three main engines. In the cutaway you can see how all three main engines feed into one main gearbox which then distributes the power through shafts to the front and rear rotors. Should one of the engines fail or be damaged in combat the other two will be able to maintain flying and lifting power. All three undercarriage legs are extensible so the HLH can raise itself up on the ground to straddle a large and awkward load.

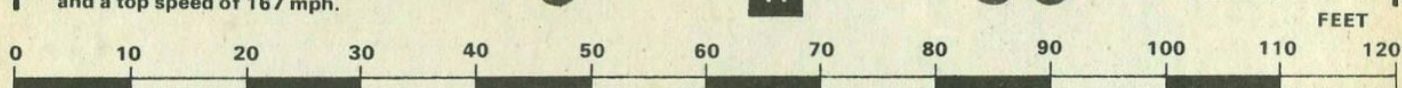
MIL V-12



A comparison in size and design between the Russian Mil V-12 and the Boeing HLH. Obvious differences are the side-by-side rotors on the V-12 and the tandem rotors on the HLH. The V-12 has a rear-loading fuselage, four 6,500 hp engines and a crew of six. Its maximum speed is 161 mph and each rotor is 114ft. 9½in. in diam. The HLH has 92ft. diam. rotors and a top speed of 167 mph.



BOEING
HLH



Modern Marvels

THE HEAVYWEIGHT LIFTERS

Flying cranes with whirling wings—these are the new breed of heavylift helicopters which are rising to the task of supplying armies from the deck of a ship or ferrying a 40 ton load to a distant oil rig

THE largest helicopter in the world is the Russian twin-rotor Mil V-12 capable of carrying a 40 ton load. Now the West has entered the heavy-weight helicopter contest with a new design, by Boeing of America, for the U.S. Army and Navy.

The Boeing Heavy Lift Helicopter (HLH) differs from the Russian Mil V-12 in two important ways. The HLH rotors are in tandem, i.e. fore and aft, while those of the Mil V-12 are side-by-side, mounted on stubby wings. Second, the Russian helicopter carries cargo inside its fuselage and is loaded through rear-mounted clam-shell doors and a ramp. The American HLH, which carries just over half the Mil V-12 payload (22.5 tons) makes use of a two-point winching system which draws

the load up under its fuselage while hovering in the air.

Power for the HLH comes from three rear-mounted 8,082 hp. turboshaft engines feeding a main gearbox. Two of the engines are mounted at an angle of 30 degrees on each side of the rear rotor pylon and the third is centrally mounted inside the tail. If one of the engines should fail the other two have enough power to keep the HLH flying with its 22 ton load.

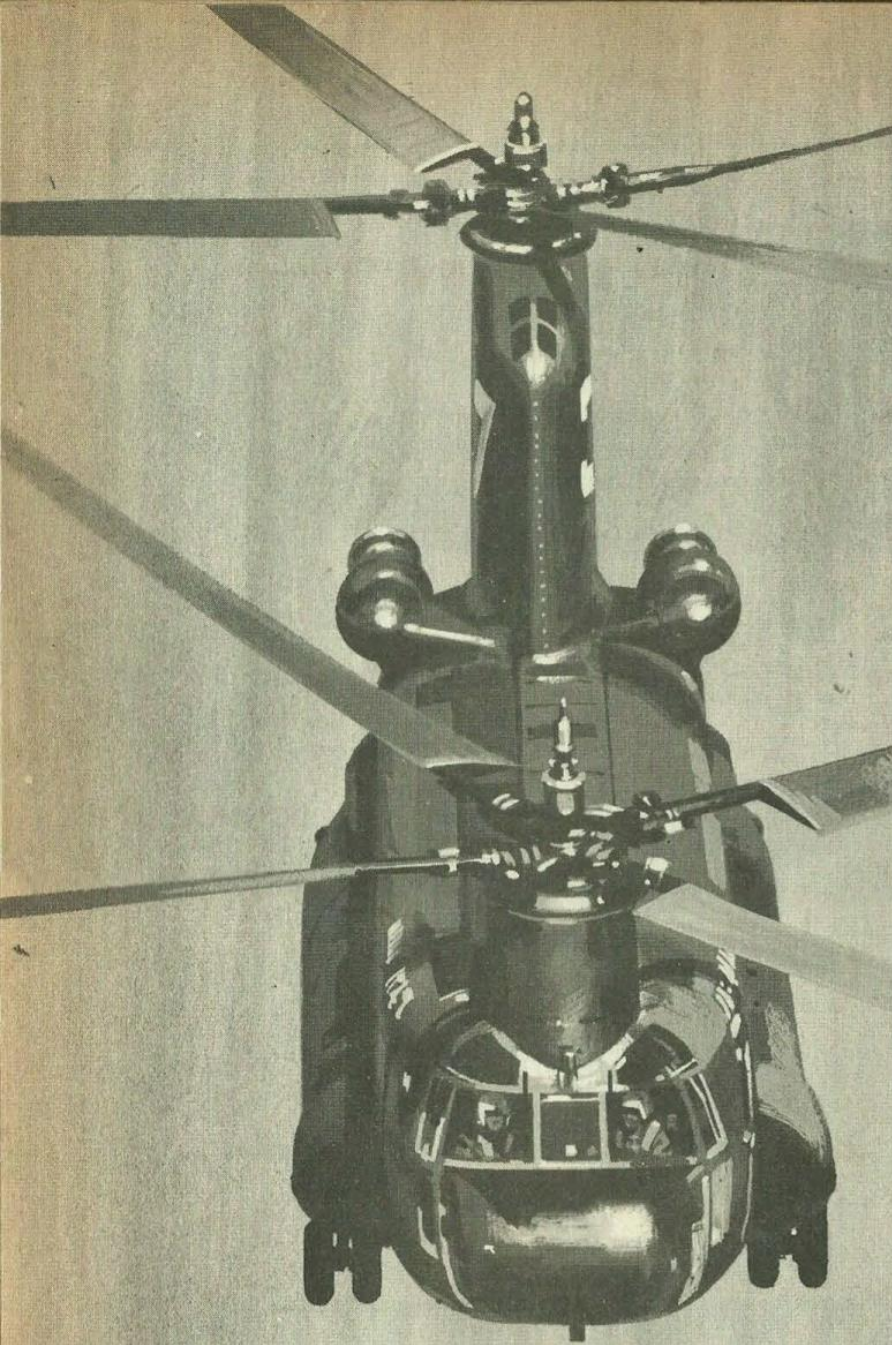
From the main gearbox a shaft extends back and up to the rear rotor gearbox mounted in a pylon that is higher than the front rotor assembly. Power for the front rotor is supplied through a shaft running through the fuselage at roof level.

The advantages of a twin system of

rotors over a single, large rotor, are fourfold. Less power is needed to lift a given load, the centre of gravity limitations are more forgiving should they be accidentally exceeded, the performance in cross-winds and while hovering is much better and the components needed to make up the two complex rotor assemblies are smaller and more readily serviceable.

Another advantage of twin rotors, turning in opposite directions, is their torque-cancelling properties. On single rotor helicopters it is necessary to have a small, vertical propeller on the tail to correct the tendency for the helicopter to turn around like a top instead of the rotor turning!

CONTINUED ON NEXT PAGE



Much of the advanced engineering and flight-control systems to be used in the HLH are being tested in a model 347 helicopter, (left) Boeing's highly modified version of the Chinook which has seen active service in Vietnam as a gunship. The 347 has also been fitted with movable wings (above) in a research programme aimed at increasing helicopter manoeuvrability and response in flight.

The blades for the rotors will be made of glass fibre with titanium (a very strong, light alloy) sheath along the leading edges to prevent wear. Carbon fibre, the revolutionary new Man-made material now used in some jet engines, was investigated as a possible material for the blades, but was found to be too susceptible to damage and wear.

The four blades for each rotor will be mounted on special bearings on a titanium hub and these will be fitted with sensors that will diagnose faults and failures in the blades and transmit them to the pilots.

An advanced fly-by-wire system will be used to control the flight-control system of the helicopter. Instead of the flying controls being connected by mechanical linkages, levers, cables and rods to the rotor blades, the controls will send electric

signals through a wiring circuit to actuate servos which will alter the pitch of the rotor hubs and the angle of the blades. The wiring system will be duplicated or even triplicated so that in the event of a failure on one circuit, the helicopter can still be controlled through a back-up circuit. The advantages of fly-by-wire is the finer degree of control which can be achieved, particularly important when the HLH is trying to hover in a strong cross-wind and pick up a load.

The two-point external cargo lift and suspension system uses winches that are powered by air fed to them from an auxiliary engine or bled off from one of the main engines. The winches can be moved along the fuselage so loads of varying lengths can be handled.

Helicopters with just a single lifting winch are easier to engineer, but loads

carried in this way tend to swing about and make it very difficult to manoeuvre the helicopter or fly it at high speed.

Flight trials with a Chinook helicopter carrying a standard 8 foot by 8 foot by 20 foot cargo container on a single-point suspension system showed that about 70 mph was the maximum speed that could be flown. When the twin-point suspension system was used, with cables attached to each end of the container, this speed was very nearly doubled. Wind tunnel tests have shown similar benefits in speed and manoeuvrability with such loads as an artillery gun, tanks and the fuselages of damaged aircraft up to the size of a F-111 swing-wing jet fighter.

A CREW OF FIVE

Aside from winching up or lowering loads while it is hovering, the HLH has an ingenious three-leg undercarriage with extendible legs. This enables the HLH to raise itself while on the ground so it can straddle an awkward shaped load before taking off with it "strapped to its belly."

A crew of five is needed to operate the Boeing HLH. These comprise the pilot, co-pilot, the loadmaster who supervises the winching operations from a rear-facing cockpit, a crew-chief and the flight-engineer.

The first flight of this "flying crane" will take place in 1974 and Boeing expect that the total number of aircraft sold, including a few for commercial use, will be 250.

A 22 ton container of medical supplies, a 17 ton Sheridan tank or a 20 ton radar unit—the Boeing HLH will soon be able to clutch any of these to her belly and fly them from ship-to-shore

THE DEFENDERS

The Story of Fortification

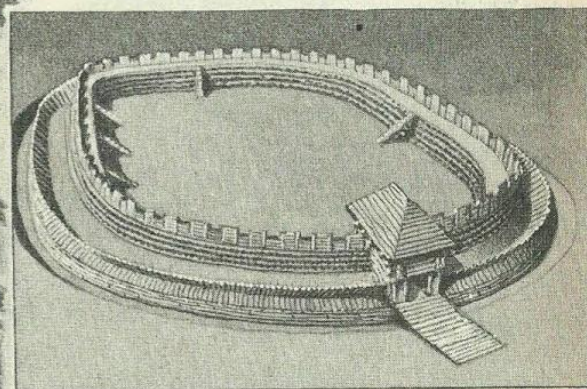
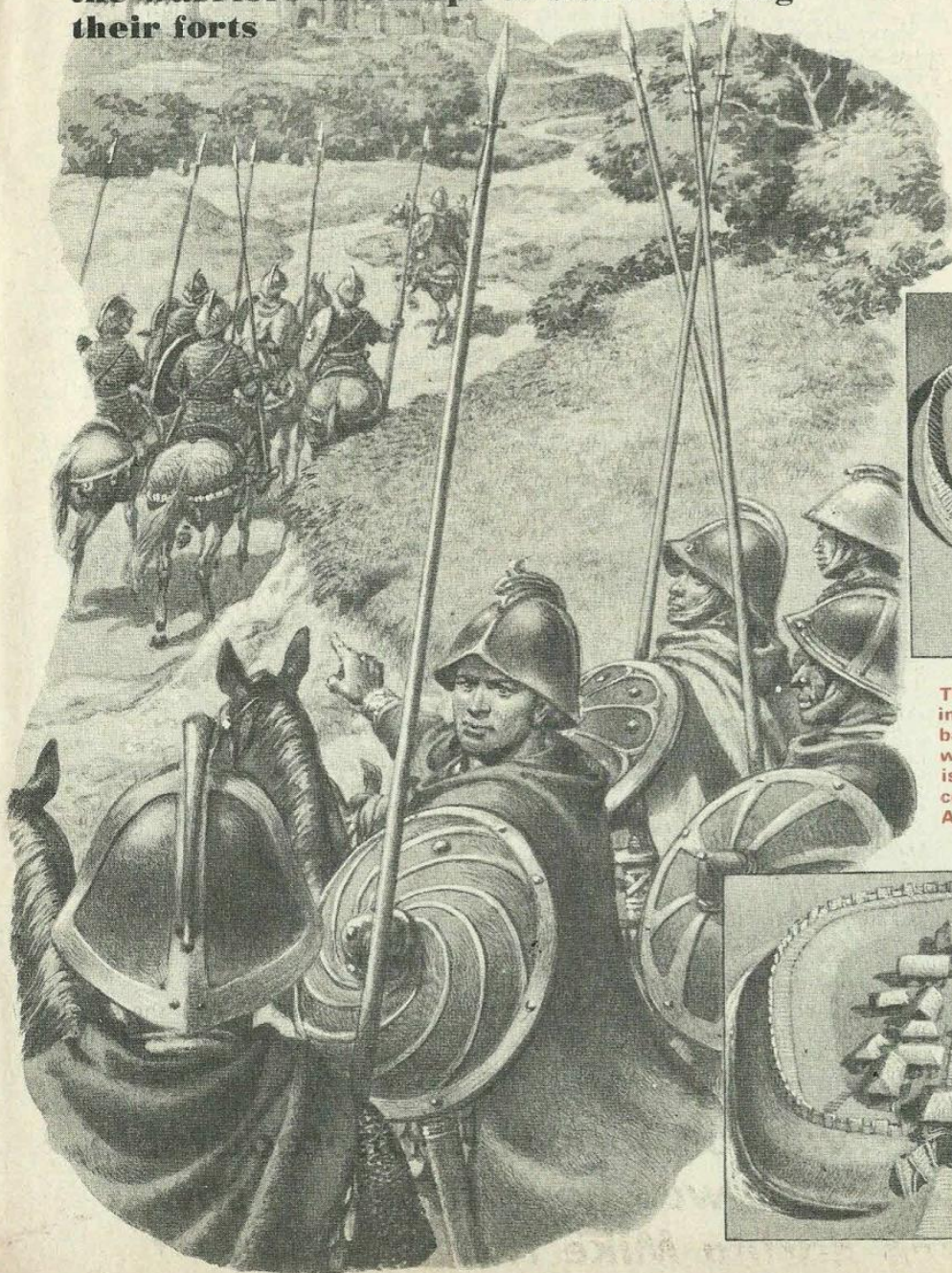
Keeping Out The Barbarians

Courage and a strong sword-arm were no longer enough to resist the aggressive Viking raiders from the North. The time had come for the warriors of Europe to start building their forts

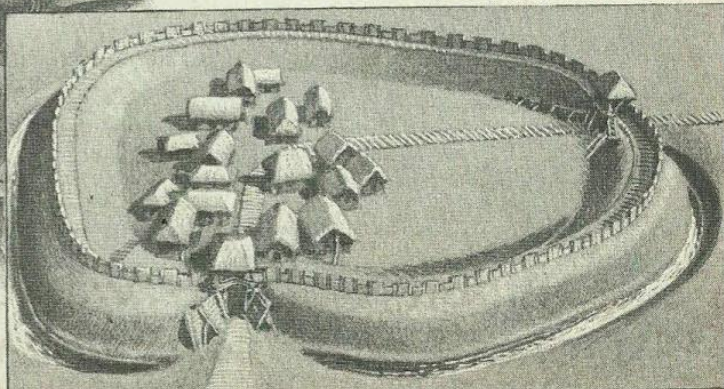
SHOULDER to shoulder stood the northern barbarians, their shields making a rampart above which fierce bearded faces roared defiance at the foe. The warrior traditions of these northern Angles, Saxons, Franks and Germans were certainly heroic but not always very sensible. Sometimes courage and a strong sword-arm were not enough.

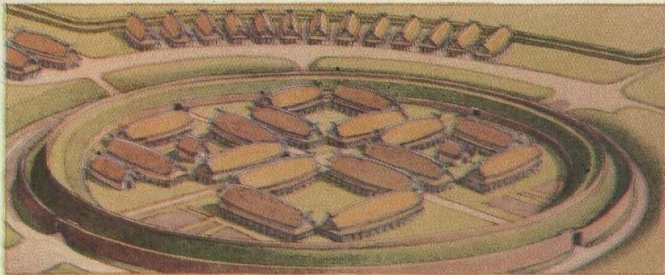
This was just what the Franks found when they set up their kingdom of France in what had been known as Gaul. Under their king Charlemagne

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The Franks, who conquered Gaul, built rather inferior copies of Roman defences (left). Other barbarian peoples continued to build their citadels with wood and earth in a more ancient style. Above is a Polish wooden fortification of the 8th or 9th century. Below is a Danish village of the Viking Age defended by wooden ramparts and gates.





Trelleborg camp in Sweden, reconstructed above, was one of the most impressive of all Viking military bases. It was very carefully planned and could accommodate 1,200 warriors in its "long houses" which were laid out with Roman-like precision.

The age of the Vikings was an age of experiment, with different people tackling the problem of defence in different ways. All over Europe citadels sprang up. These became the new symbol of a local lord's power

In Scandinavia lived the Vikings, the most ferocious and feared of all the peoples who lived outside the frontiers of civilization. Suddenly in the ninth century they burst out of their cold northern lairs to raid and pillage across Europe. From longboats beached on the coasts they plundered the defenceless lands of England, France and Ireland. If they met resistance they would build fortified base-camps in the most inaccessible and marshy parts of the coast.

SYMBOL OF POWER

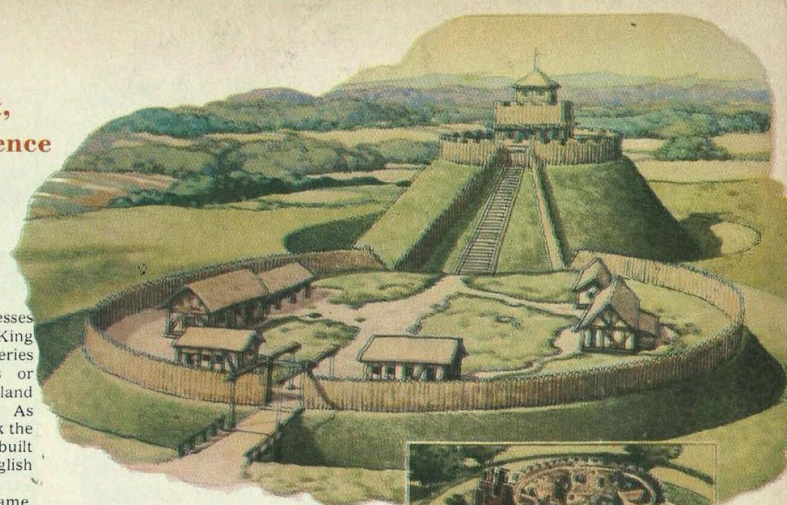
The kings of Europe had terrible trouble winking the Viking raiders out of these strongly defended bases, for the camps were well designed by warriors who had long experience of building strongholds back in their Scandinavian homeland. One of the biggest Viking camps was at Trelleborg in Sweden. 1,200 fighting men could live within its huge circular rampart and ditch in 'long-houses' like barracks laid out with Roman-like precision.

The only way the English and French could resist these Viking raiders was to

copy them and start building fortresses of their own. This is exactly what King Alfred did in England. He built a series of walled towns called burghs or boroughs all over that part of England not conquered by the Vikings. As Alfred's successors slowly won back the Viking-occupied areas they also built burghs as rallying points for the English forces.

The French kings did the same, confining the Vikings within the area of France we now call Normandy. Meanwhile the Irish were also suffering from Viking raids. They tackled the problem in a different way, for though there were few towns in Ireland, there were many rich monasteries and these were what the gold-hungry raiders were after. The monks built tall slender towers whose only entrance was a small door high up one side and into these they scamped with their books and treasures whenever the Vikings appeared.

In Germany the local lords were also building towers quite unlike anything to be seen in England or France. They were immensely strong so that few were ever captured, but they were so cramped



Above is a reconstruction of the motte and bailey type of wooden castle which the Normans built. The earth motte, or mound was surmounted by a wooden castle and a large open space known as the bailey was well defended by a drawbridge and dry moat.



Two rather unusual kinds of castles were the shell keep like that of Restormel Castle in Cornwall (above top) which can still be seen today. An earth bank was built up against the outer wall of the fortress. There was also the solid keep like that at Farnham (above) where the stone castle was built around a natural hillock and was itself filled with earth.

ped that they must have been awful to live in.

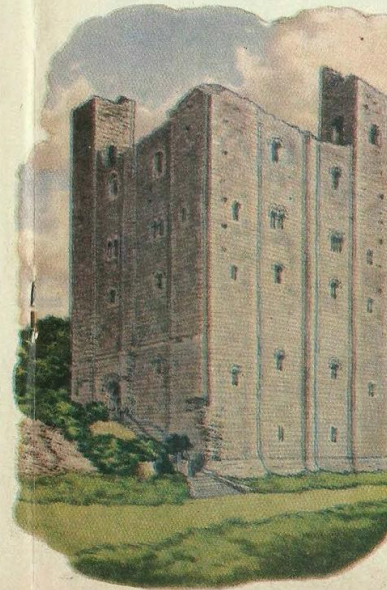
The age of the Vikings was an age of experiment, with different people tackling the problem of defence in different ways. Each local lord had to look after himself and his peasants. The castle on the hill, whether stone tower or wooden rampart, became the symbol of power.

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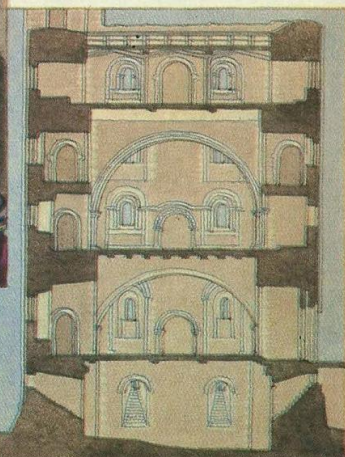
Many of the wooden and stone castles built by the Normans are shown on the Bayeux tapestry. Below is a detail of this tapestry showing the Duke Conan of Brittany escaping from the wooden castle of Dol by sliding down a rope while the Normans are attacking it.



Victims of the Viking raids had to defend themselves as well as they could. Irish monks built strange tall towers (above) which still stand today. Most of these towers had doors high up on one side so that no enemy could get into them once the ladder had been drawn up.



A better known type of 12th century castle was the stone-built Donjon or square keep. One of the best examples in England is at Hedingham in Essex (left). Spiral stairs (above) were built into the angle-wall of the keep. Each step had a circular piece at the end which formed the central column of the staircase when it was built. A section through Hedingham (right) shows the stout walls with wooden floors supported by a pair of stone arches.

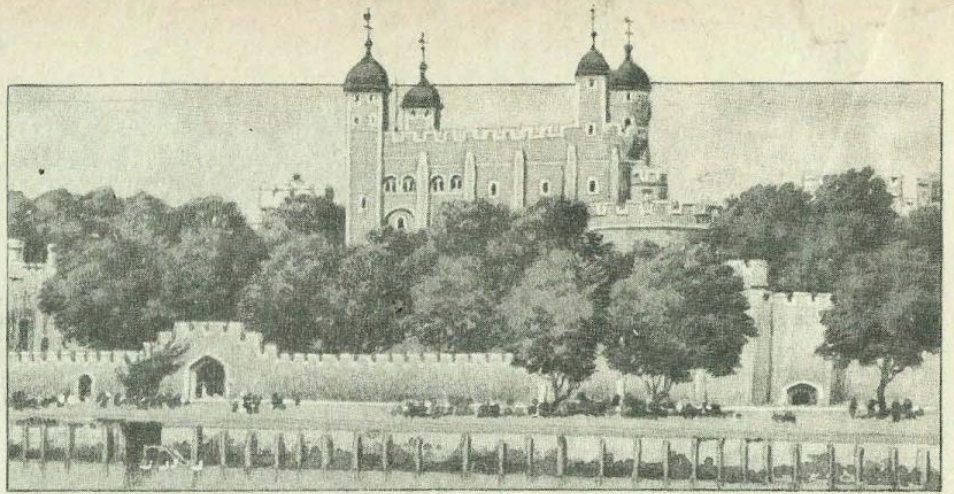


Once the Vikings settled down in northern France they became what we know as the Normans, the most aggressive and adventurous people of their day. They developed the best army and the best castles in Europe— castles we call 'motte and bailey' forts. The motte was a mound of earth or a natural hill, and on top of this the warrior-lord built a wooden stockade around a wooden keep or tower. Below the motte was a larger stockaded area called the bailey.

Though these wooden castles could be built in a very short while, they were surprisingly strong. One such 11th century fortress was described by the chronicler Lambert d'Ardres as having three floors of halls, chambers, guard-room and chapel all of wood! Of course, the great drawback with a wooden castle was the danger of fire so whenever possible the Normans built with stone. Stone castles were usually built on ground level because a man-made hill would probably have collapsed under the weight of a stone castle.

These stone castles came in various shapes. One type was the shell-keep, such as the castle that can still be seen at Restormel in Cornwall. A circular wall surrounded by a ditch enclosed a small area with all the rooms of the castle facing inwards onto a courtyard. Another type of Norman castle was the solid keep like that of Farnham castle in Surrey. It was built around a natural hillock whose sides were cut steeply away. Living-quarters would have stood on top of the castle and had any enemy ever breached the wall, he would have come up against nothing more than solid rock.

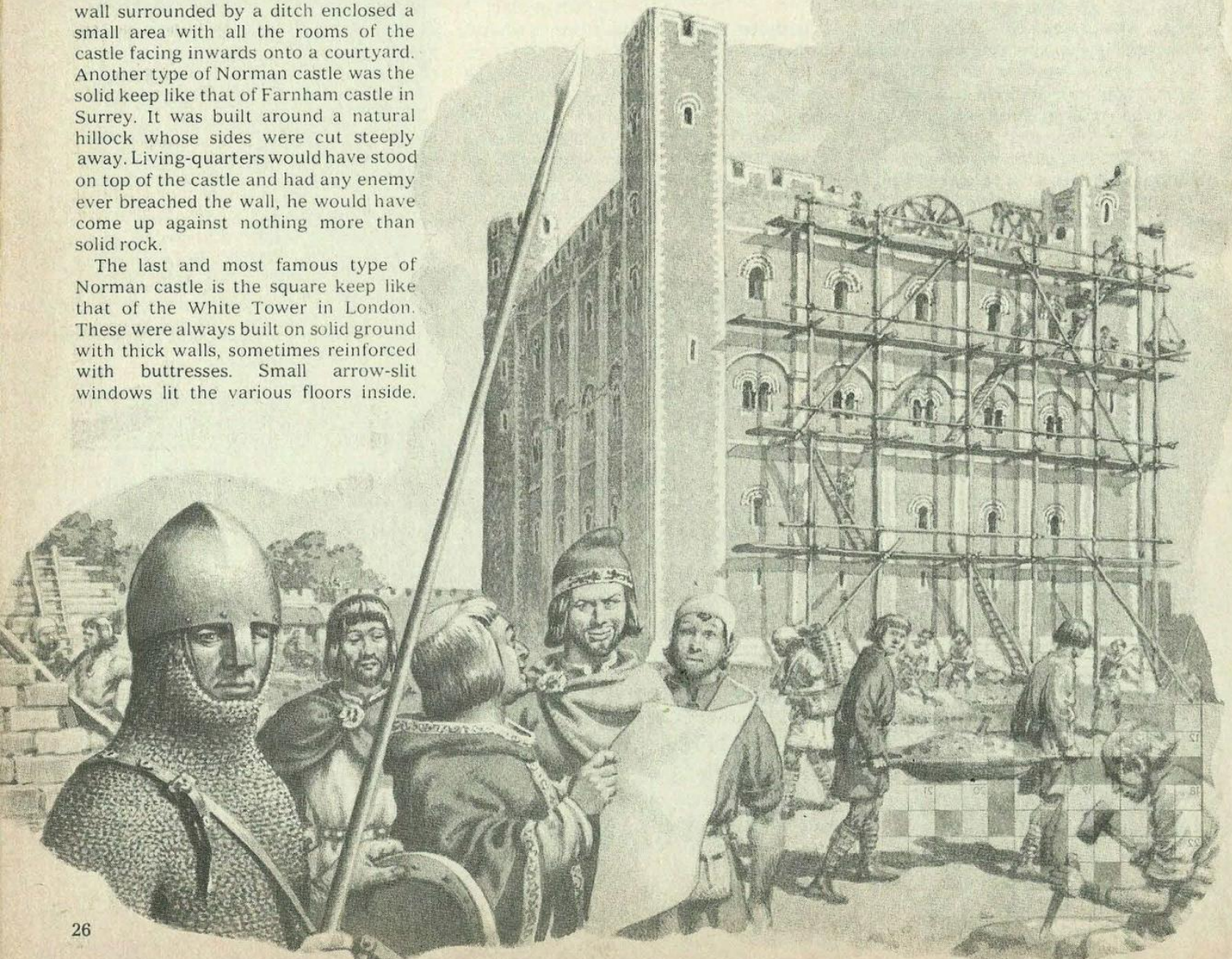
The last and most famous type of Norman castle is the square keep like that of the White Tower in London. These were always built on solid ground with thick walls, sometimes reinforced with buttresses. Small arrow-slit windows lit the various floors inside.



Although these square keeps were strong and impressive they were still primitive in design.

Defensive fire could only be directed straight out or down from the walls. There were no towers or turrets to give lateral or cross-fire. To discover these ideas the warlike Normans had to go travelling to the more advanced countries around the Mediterranean, and this they did when they went on a Crusade. We shall be taking a look at Saracen and Crusader castles next week.

Perhaps the most famous Norman keep is the White Tower at the Tower of London (above). Its large windows are not, however, original, but were added many centuries later. The first windows were tiny to stop enemy arrows and stones from breaking in. William the Conqueror ordered the tower to be built and although work on it probably started in 1078, it still had not been completed when his son, Rufus, became king.



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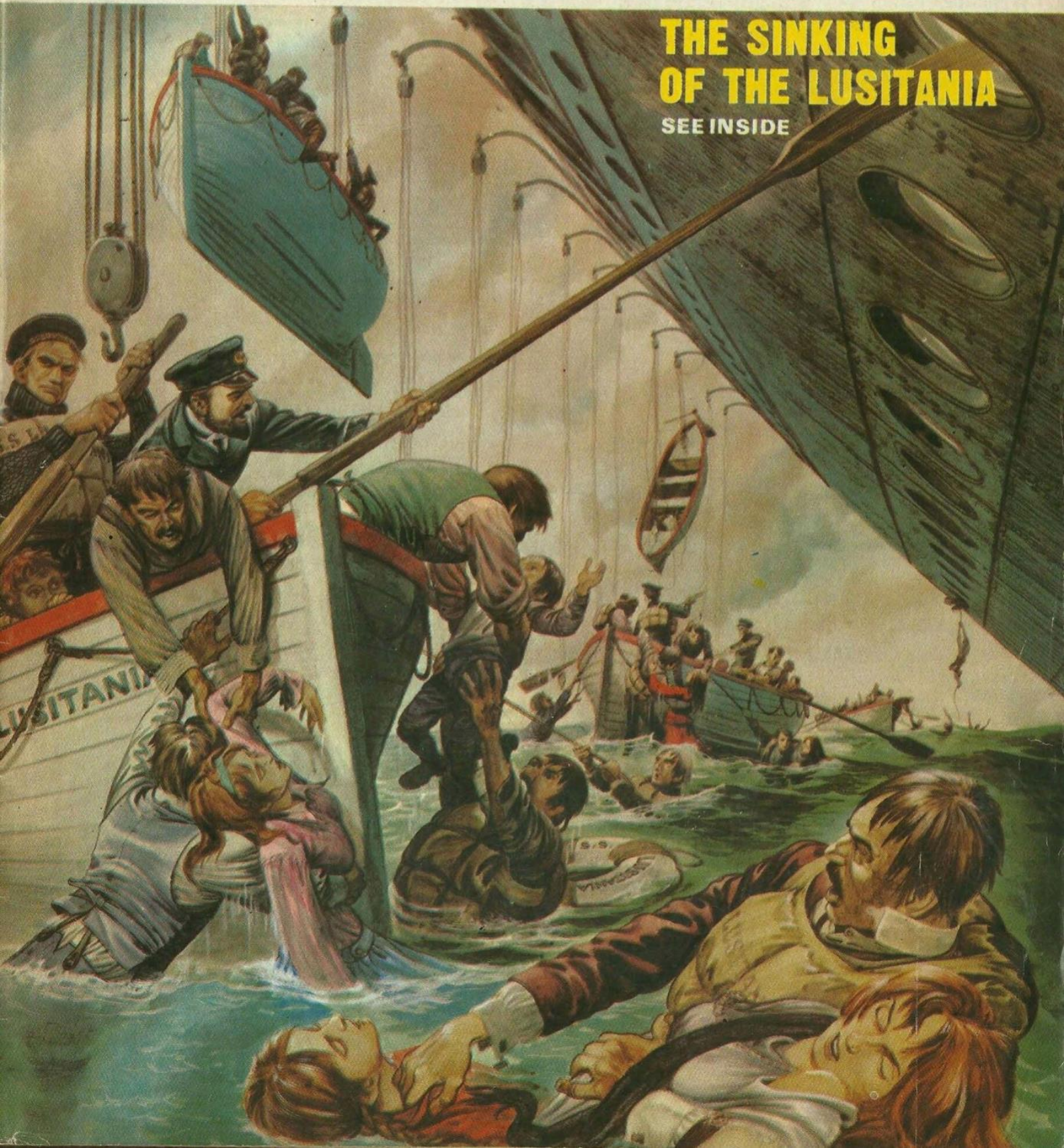
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**THE SINKING
OF THE LUSITANIA**
SEE INSIDE



This man is "seeing" through his skin. Objects seen by a television camera worn on his head are felt as tingling pulses from the corset at his waist which his brain turns into pictures.

How Science Works - For YOU

Marvellous devices which enable blind persons to read the printed word, to find their way about, and even to see and recognise friends and places are among the wonderful advances being made by scientists



BLINDNESS is a distressing handicap. While many sightless people manage to overcome the disaster in their lives which causes them to exist in perpetual darkness, others find blindness a serious handicap to their way of life.

For years, scientists have tried to solve the problem by experimenting with radar type devices that guide a person by beeping when obstacles are in the way. But none has yet managed to supersede the trustworthy white stick and the reliable, well-trained dog.

Nevertheless, there are many things a blind person cannot do, and reading the printed word and such a simple pleasure as recognising a friend from his appearance are but two of them.

Now, scientists have come up with another solution which involves using the skin as a substitute for the eye's retina, the organ which turns light rays into nerve signals which the brain converts into mental pictures.

Like the retina, the skin contains a two-dimensional sheet of receivers which can transmit pattern information to the brain. Light stimulates the retina's receivers. In a new system being developed in America, electronic pulses stimulate the skin receivers.

To make the system work, a midget television camera is mounted on the frame of a pair of glasses worn by the blind person. He directs the camera by pointing his head.

The camera's signals are passed to a flexible corset worn around the waist. Woven into the corset is a six inch square matrix holding 256 electrodes.

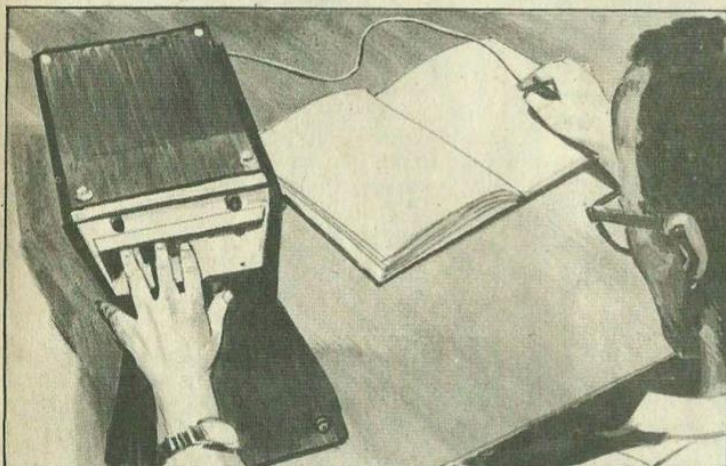
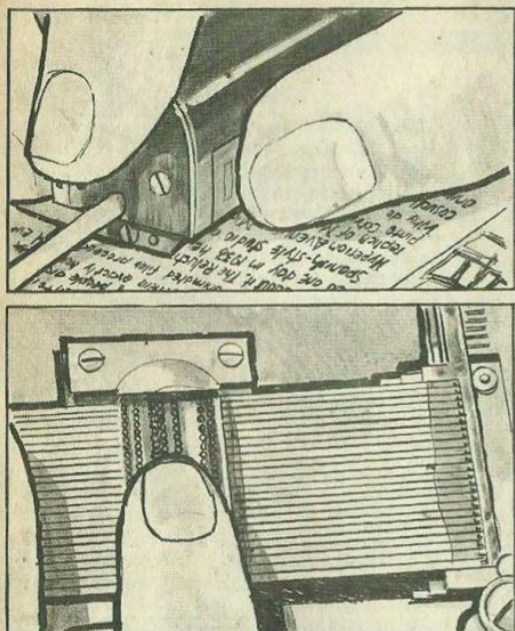
These send thousands of tingling, tickling electrical pulses to the skin, and the nervous system carries them to the brain. A blind person receives these pulses as a crude, but recognisable, image of what is before him.

With this device, blind people have been able to recognise people, identify objects and tell the difference between light and shadow. At the moment, they can see only in black and white, but scientists are looking forward to the day when the television camera will provide pictures in colour.

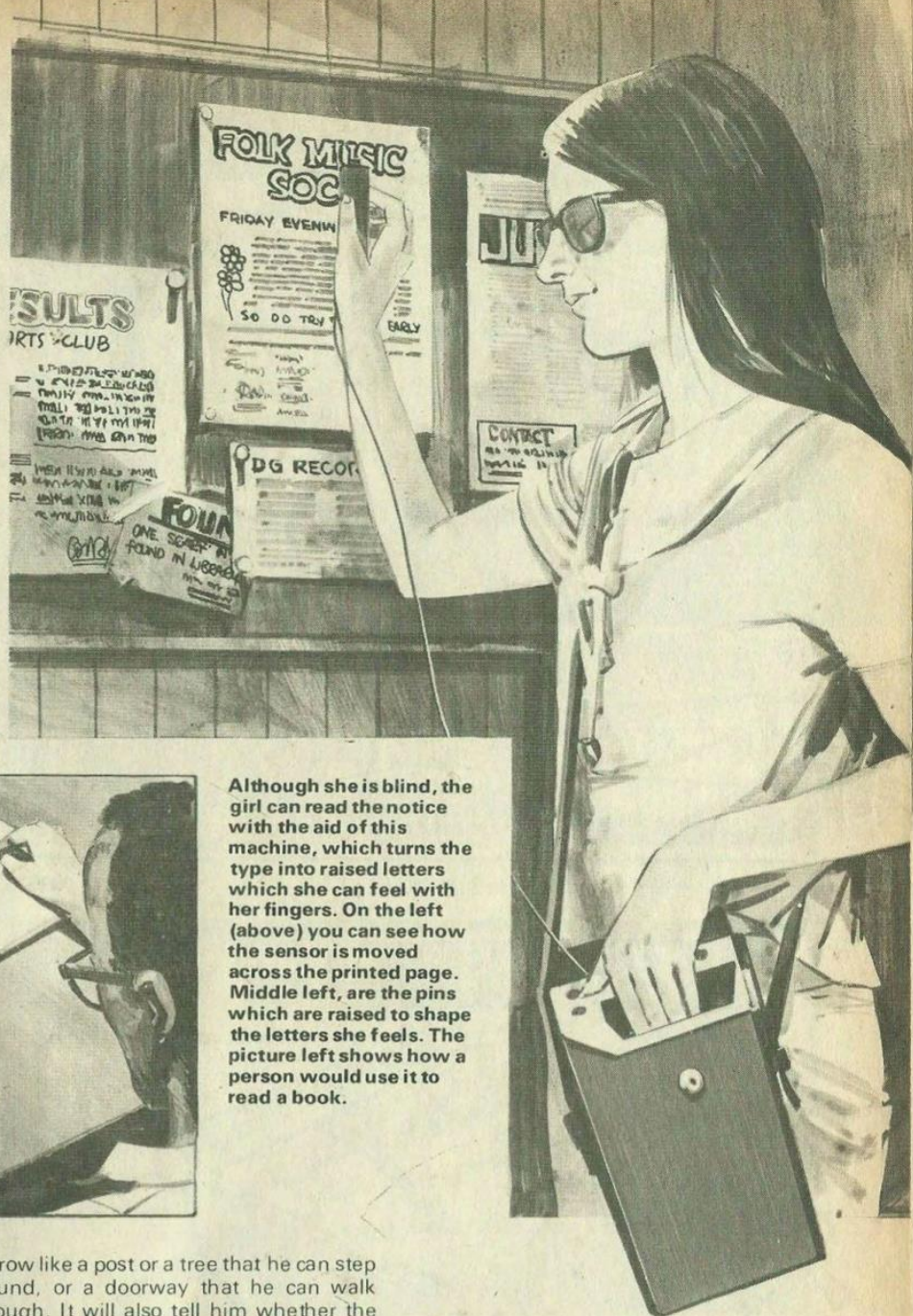
The inventor, Dr. Carter Compton Collins, began his experiments with a 400-pound camera mounted on a dentist's chair and used mechanical vibrations against a person's back to transmit images.

In the future, Collins hopes to design a mass-produced version of his device in

TEACHING THE BLIND TO 'SEE'



Although she is blind, the girl can read the notice with the aid of this machine, which turns the type into raised letters which she can feel with her fingers. On the left (above) you can see how the sensor is moved across the printed page. Middle left, are the pins which are raised to shape the letters she feels. The picture left shows how a person would use it to read a book.



two or three years, giving a much sharper picture in colour.

He is also experimenting with similar sensing devices that would allow a deaf person to "hear" or an amputee to "feel" with an artificial limb.

Collins began his work because he saw the need, as a doctor, for some means of enabling the blind to see. Another man with the same need in mind is Forrest M. Mims, a young electronics engineer. His device works something like sonar and radar, except that invisible infra-red light rays are used instead of sound pulses or radio waves.

WARNING NOTE

The blind person wears a pair of ordinary sunglasses to which are attached two slender tubes. From one, infra-red rays are transmitted in a pulsating beam. When the beams strike an object, some of them are reflected back and sensed by a device in the second tube.

This sets off a warning note which is heard through a tiny tube inserted in the user's ear. By moving his head from side to side or up and down, the blind person can tell if the object in front of him is

narrow like a post or a tree that he can step around, or a doorway that he can walk through. It will also tell him whether the obstacle is broad and flat, such as a wall or a fence, which he must turn away from.

This device has an advantage over guide dogs and canes in that it closely approximates the position and movements of a person's eyes. They "look" wherever the user looks in imitation of normal vision.

Objects above waist level are also detected, such as low-hanging signs, awnings and tree branches that a stick might easily miss.

Objects up to fifty feet away could be detected, but this would be confusing for the user. Instead, the tubes are angled so that their fields of view meet a few feet ahead of the user. In this way, the coverage is limited to objects within immediate range.

It is also helpful in finding desired objects. When a person goes into a room, for example, he can find a chair by scanning the area briefly until signals resembling the size and shape of the chair are heard. Users, with practice, are soon able to tell different objects by learning the signal patterns.

For the moment, this invention can only

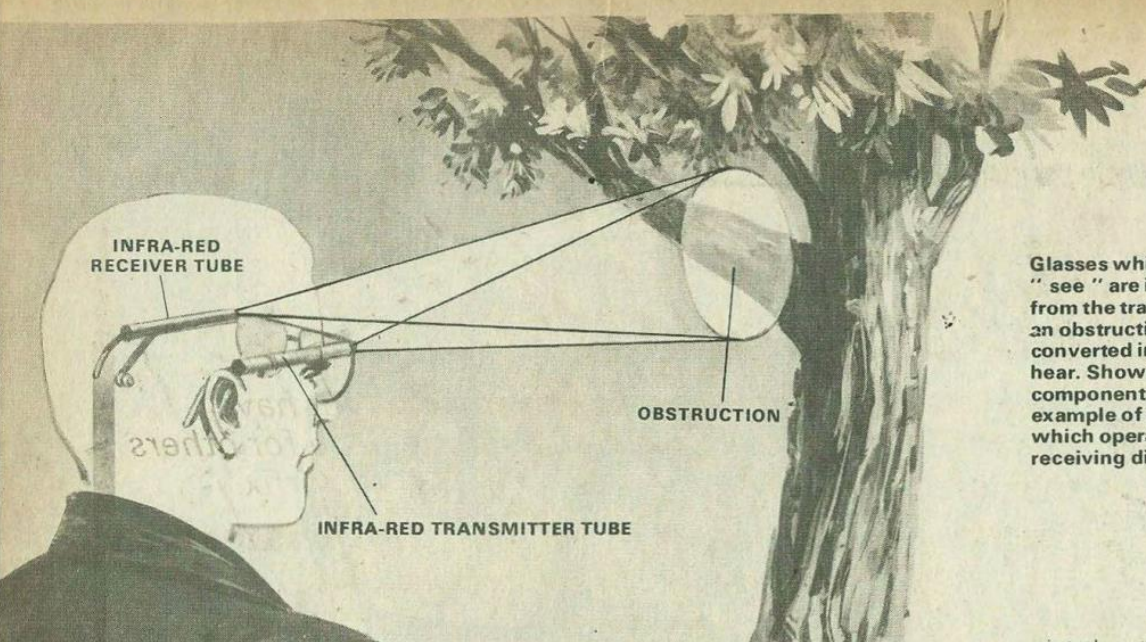
signal for a fixed range. But more advanced versions are being experimented upon by Mims. His idea, is to have devices that contain two or more infra-red beams pulsed at different frequencies and aimed to meet at different distances.

A different warning tone would be set off by each infra-red frequency. A user would hear one note, for example, at eight to ten feet, another at four to five feet and a final one at one to two feet. Not only would he know how far away an object was, but also how fast it was approaching.

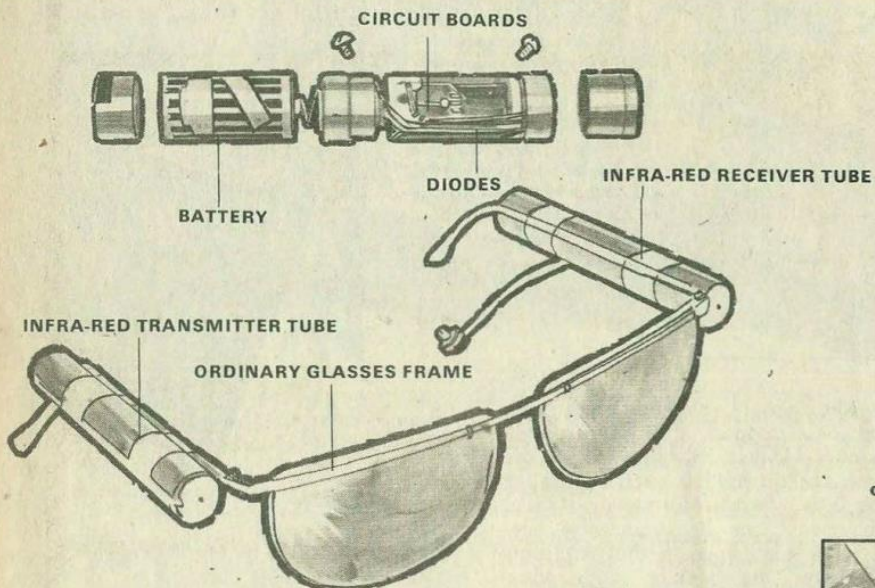
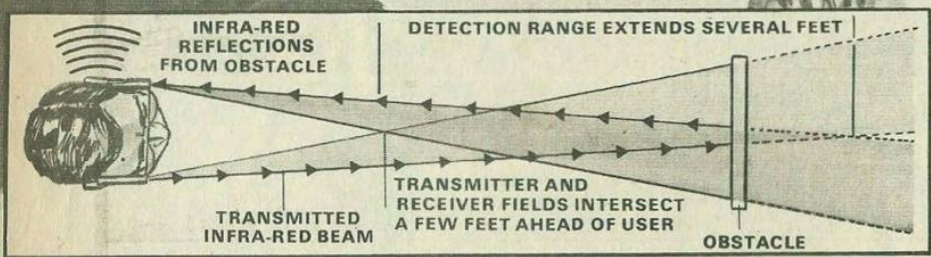
Although this is not the only "seeing" device being developed for the blind, it is so far one of the smallest and cheapest. Each of the transmitter and receiver tubes is only half an inch in diameter and three-and-a-half inches long. Altogether, they weigh less than three ounces, including batteries and the spectacles' frame. The price is expected to be not much more than that of a good quality hearing aid.

While these inventions help the blind to get about, they do not assist them to read

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Glasses which enable blind people to "see" are illustrated here. Infra-red rays from the transmitter tube are reflected by an obstruction to the receiver tube and converted into a note which the user can hear. Shown below left are the components of this device, with an example of the equipment in each tube which operates a light emitting or receiving diode, a form of transistor.



printed matter. For this, there is a device called the Optacon, which is about the size of a shoulder-strap tape recorder. When the user runs a photo-electric sensor along a line of printed type, the letters are turned into shapes by tiny, vibrating pins, which can be felt. Should the letter A be scanned, the pins vibrate in the shape of a letter A. By keeping his finger pressed tightly against the pins, the user can feel the shapes of the letters as the sensor is slid along the line of type.

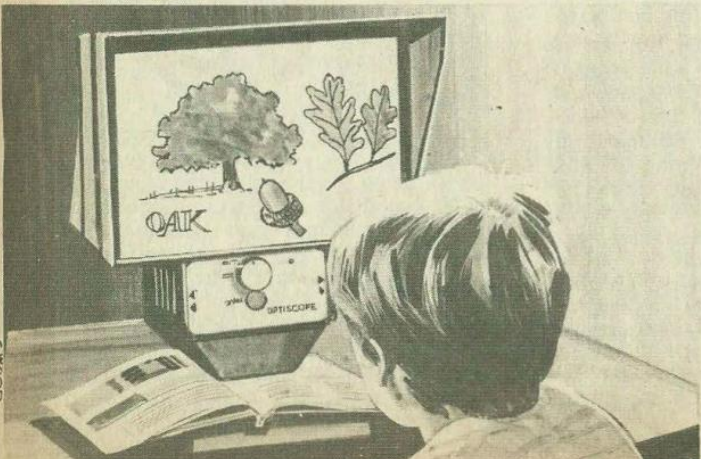
After some practice, users can read very quickly, up to 150 words a minute, and can even read a newspaper in a train.

Similar to this is the Optophone, developed in England. This uses a moving beam of light to scan the printed words and turns them into tones, something like the Morse code. This, however, is not portable.

Over the years, electronics have made tremendous strides, but in no other field is their value so great as in helping the disabled to overcome their handicap — to give sight to the blind.

Below is a machine called an Optophone which turns printed type into a different note for each letter of the alphabet. A person can learn to recognise entire words almost at once from their "tune."

People whose sight is extremely poor can be helped by the illuminated viewer, below, which creates a greatly enlarged image on a screen.



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MERRY CHRISTMAS TO ALL OUR READERS

BRINGING IN THE YULE LOG SEE INSIDE

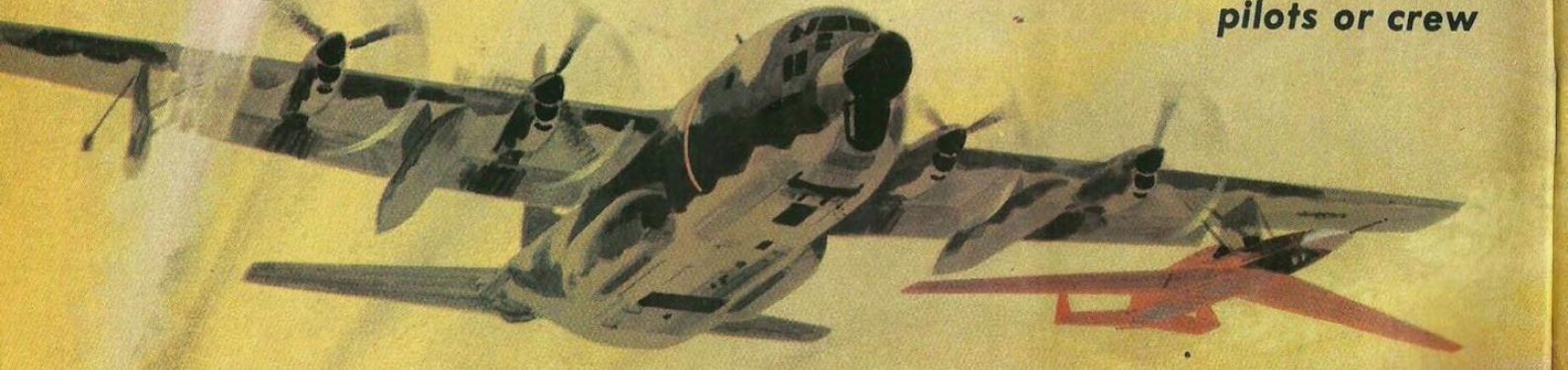




Modern Marvels

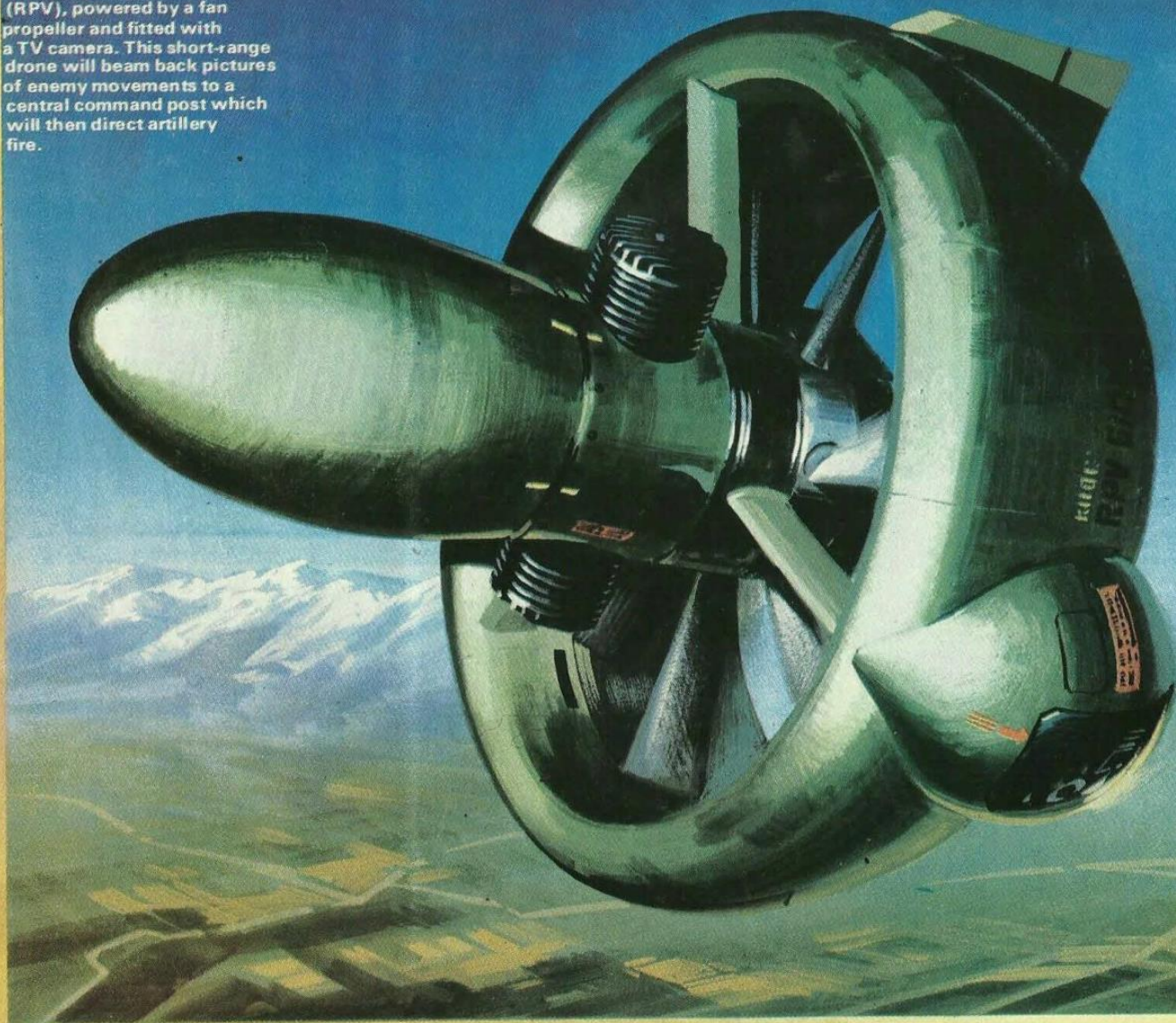
HIGH— FLYING SPIES

**Like huge radio-controlled models, these unmanned aircraft
flit through the skies on spying missions for the military,
automatically photographing the enemy
below without risk to
pilots or crew**



A Ryan 154 Firefly drone is launched from a pylon under the wing of the command aircraft, a Lockheed DC-130. Its navigational system is pre-set and once it has flown its reconnaissance mission and taken photographs it will return to where the command aircraft is circling and be recovered in mid-air by helicopters.

A Remote Piloted Vehicle (RPV), powered by a fan propeller and fitted with a TV camera. This short-range drone will beam back pictures of enemy movements to a central command post which will then direct artillery fire.



OVER 60,000 feet above hostile territory a tiny speck, invisible to enemy ground radar, flits across the sky, continuously taking photographs of enemy troop movements and military installations dotting the countryside below. The tiny speck is a small aircraft flying at a speed of 450 mph. It has travelled 700 miles since it was launched, but of the pilot there is no sign for this aircraft is an unmanned reconnaissance drone, programmed to fly a certain path, take photographs and return to its base.

For many years pilotless aircraft, or drones, have been used for target practice and for testing ground-to-air and air-to-air missiles. In recent years their use has been extended to carrying out military reconnaissance over enemy territory, with great success. At a fraction of the cost of a manned reconnaissance aircraft, these small, remotely-controlled drones have been used to return photographs of hostile military installations, troop movements, or the effects of a bombing attack, without risking the lives of pilots or crew. In one

instance two manned aircraft sent to photograph the effects of a bombing raid on a bridge were shot down. A drone was used for the third attempt and this returned safely with the material needed.

Military strategists now believe that such drones will help to keep wars, if they are going to happen at all, at a low-pitch, for with human involvement reduced to a minimum, what country will be willing to fight a "remotely-controlled war in the air" when all that is achieved is the destruction of machines that can be produced in unlimited numbers?

ELUSIVE 'FIREFLY'

The United States Government is now stepping up the development of high and low-altitude drones and American aircraft companies are designing unmanned aircraft capable of remaining aloft for 24 hours on photographic and electronic reconnaissance missions.

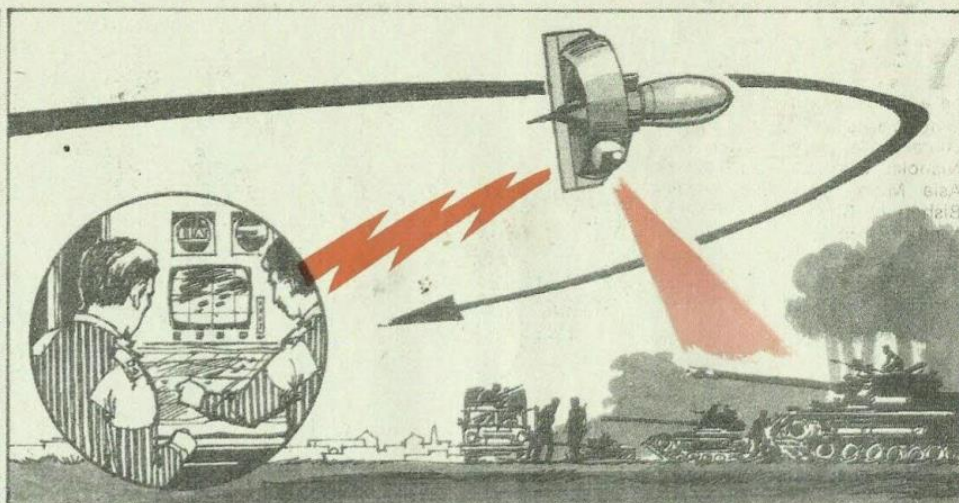
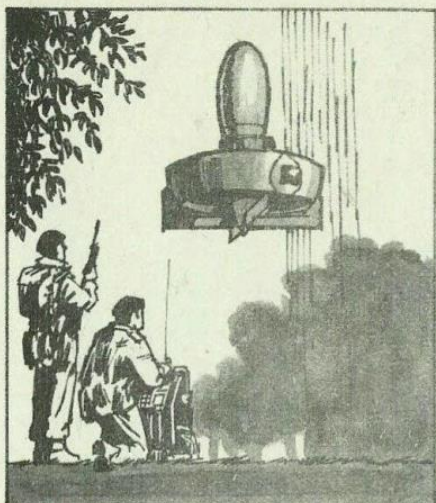
The Ryan high-altitude 154 Firefly belongs to one of the "new generation"

drones. It has a wing span of 49 feet and is especially designed to make the enemy's task of locating and tracking it with radar extremely difficult.

The fuselage is slim and its surfaces are rounded to prevent any sharp corners reflecting radar waves. The underside is flat and would only be visible to ground radar that was directly beneath the drone. The likelihood of a ground radar unit searching the sky directly above itself, when the aircraft happens to be in level flight, is extremely rare. The two vertical stabilisers on the tailplane are tilted inwards to deflect radar waves. Similarly, the small jet engine which powers the drone is mounted atop the fuselage so that its hot exhaust is shielded by the tail. This would force an intercepting aircraft armed with infra-red heat-seeking air-to-air missiles to climb above the drone flying at 60,000 feet if it hoped to get a satisfactory shot.

The wings of the drone will probably be made of plastic, a material "trans-

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parent" to radar waves and all metal parts on the fuselage will have a special coating that further confuses radar signals and prevents detection by the enemy.

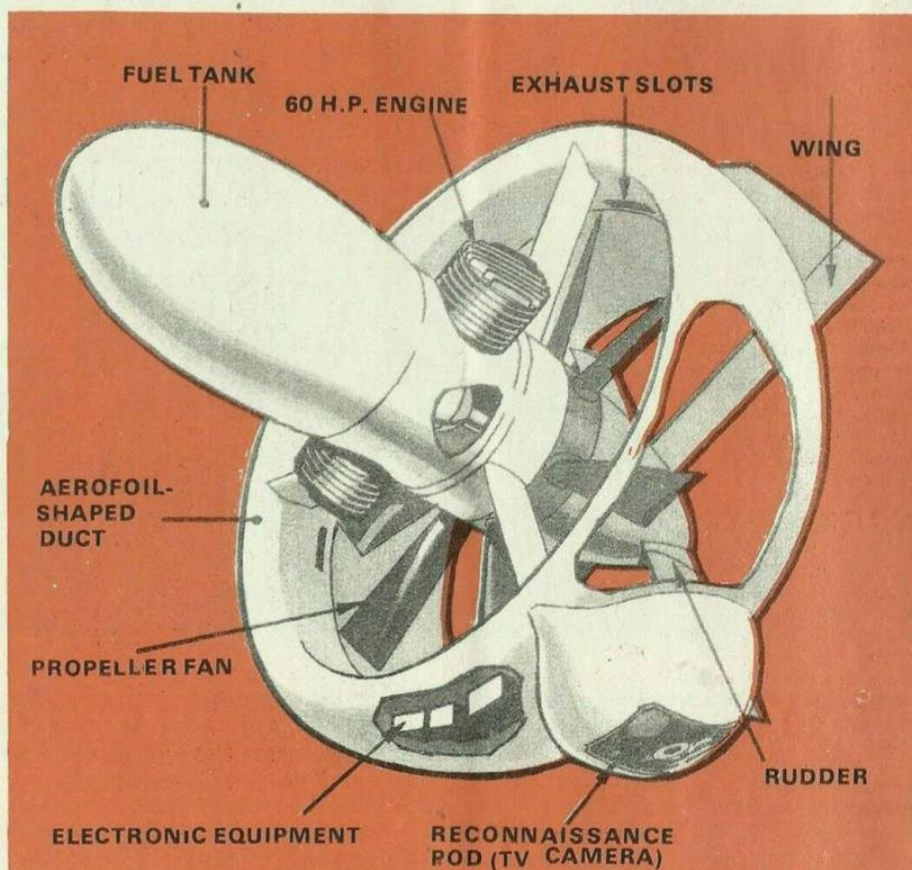
Long-range drones, flying as far as 1,500 miles on a round trip will carry special automatic navigation and flying control equipment that is "programmed" before a flight begins. This equipment automatically guides the drone on a pre-determined course and height over hostile territory, works the reconnaissance camera and guides the drone back to the recovery area. There is no undercarriage on the drone as it is designed to be launched and recovered from the air. Once it comes within 200 miles of the circling command aircraft that launched it, radio signals guide it accurately back to the pick-up zone and then deploy a system of parachutes which allows the drone to be "caught" in mid-air by specially equipped helicopters.

LOW-FLYERS

For its reconnaissance work the drone carries a panoramic camera which can take 1,500 photographs, each about 45 inches long and 4.5 inches wide.

Low-altitude drones, flying at about 1,500 feet are already in frequent use. They have a limited range of 150 miles and can be controlled by radio transmitters, just like a huge radio-controlled model aircraft. They can carry television cameras which beam "live" pictures to a ground command centre and can be used to direct artillery fire, and air attacks and spy on enemy troop movements. This system has the advantage of showing to the controller exactly how and where the drone is flying at any given moment and he can make the necessary alterations to course and height as it flies over its selected target zone.

The British Army is also interested in the use of Remote Piloted Vehicles (RPV) for battlefield reconnaissance. One design, by Shorts aircraft company, is very different from the conventional drones. Nicknamed "Skyspy," this RPV is designed to take-off vertically from a forest



Controlled by a portable transmitter, the RPV will be able to take-off and land vertically in a forest clearing (above left) or the deck of a ship. Once it has tilted forward into horizontal flight its camera and electronic radar detection units will send back pictures and data. Its range is limited for the operator must be able to keep it in sight so he can control its course and altitude.

clearing or the deck of a ship. It consists of a short fuselage with a rear-mounted fan-propeller surrounded by an aerodynamic shroud or duct which acts as a wing. A bulbous nose contains fuel for the 60 h.p. air-cooled engine.

The engine exhaust emerges through slots in the circular duct and is quickly dispelled in the airstream to reduce the chances of an infra-red heat-seeking rocket destroying the RPV by detecting the hot gases. The small size of the vehicle, measuring only 16 feet by six feet, also minimises the risk of detection.

Once the RPV has taken-off vertically it

will tilt forward until it is at such an angle as to give forward flight and lift. Its maximum speed will be about 125 to 150 mph and its range will be limited because the operator has to keep it in sight while he is guiding it with the portable radio transmitter. The RPV will be fitted with a television camera to beam back pictures of the enemy troop movements and the disposition of their armoured forces to a central command post. Electronic equipment will also pinpoint the position of enemy ground radar. This RPV can lift 55lbs of equipment, fly to 20,000 feet and can stay in the air for about one hour.

THE DEFENDERS

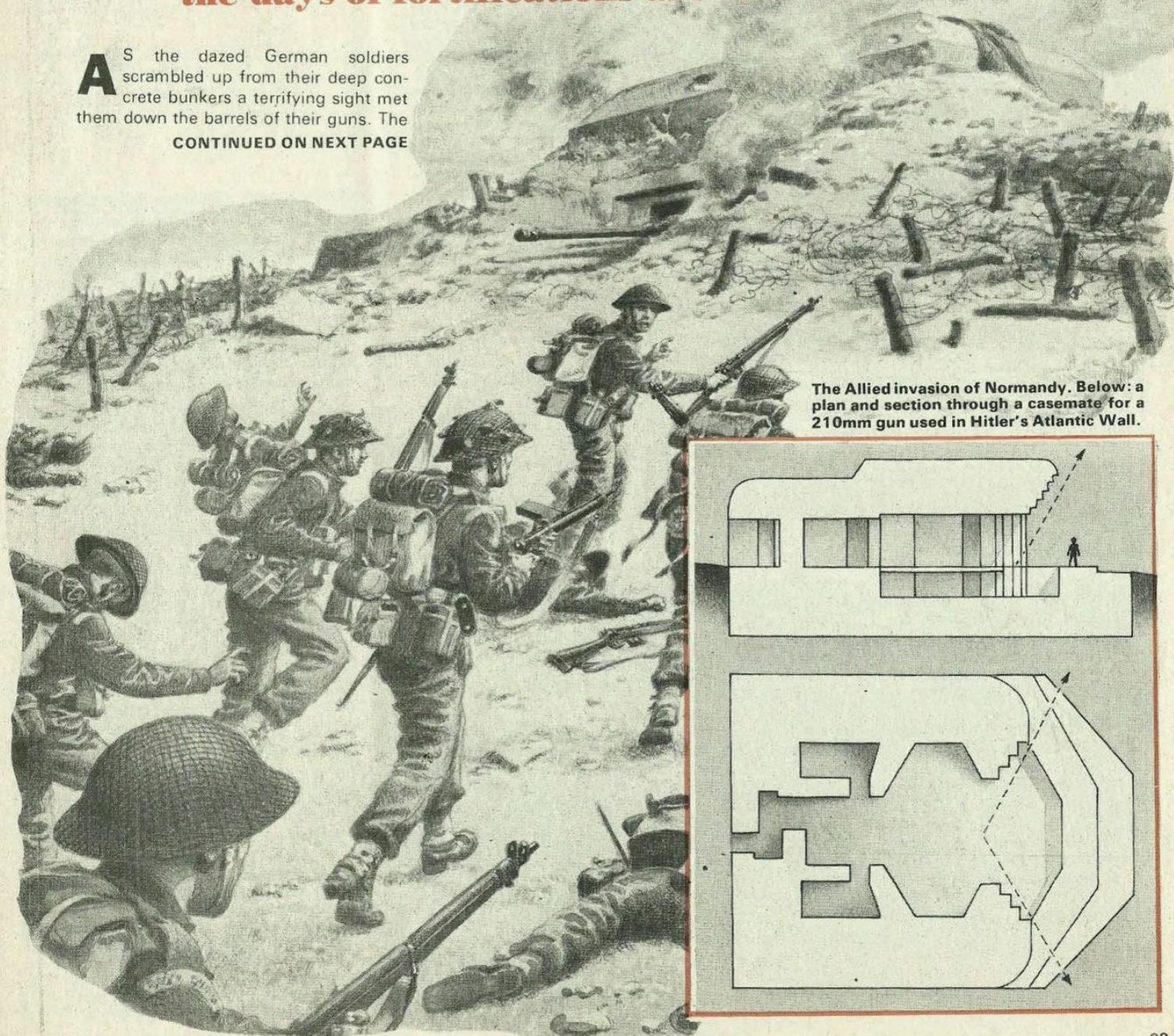
The Story of Fortification

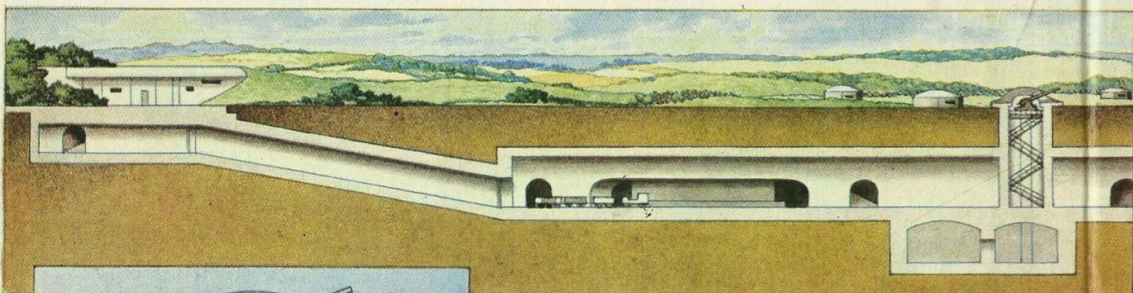
THE ROAD TO THE NUCLEAR NIGHTMARE

**After anti-tank defences came anti-aircraft forts.
And even now, with the nuclear age upon us,
the days of fortifications are still not over**

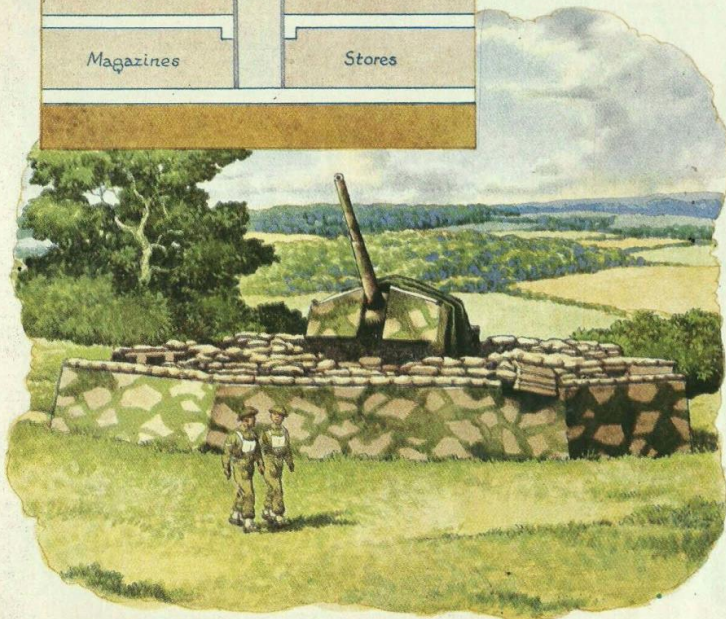
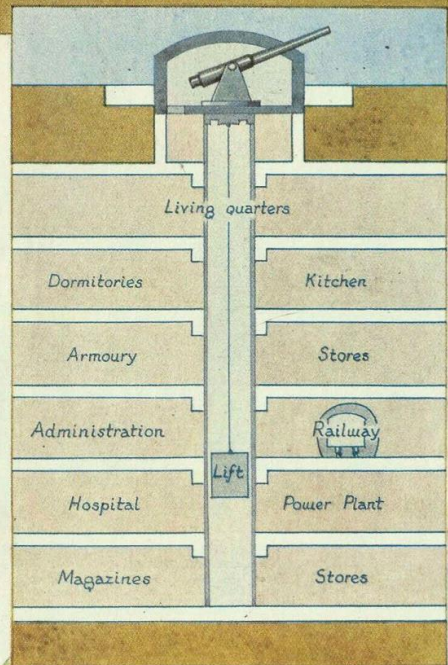
AS the dazed German soldiers scrambled up from their deep concrete bunkers a terrifying sight met them down the barrels of their guns. The

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The Maginot Line was the most elaborate system of fixed defences the world had ever seen. It had underground tunnels, living quarters, storerooms and railways. Some of its forts were sunk 200 feet in the ground. A section through one fort (left) shows just how deep the French defenders dug to keep their army safe from aerial bombardment.



During the Second World War defence engineers had a new problem to face. Attacks now came from a new direction—from the air

sea seemed covered with landing-craft beyond which lay the big ships, their sides twinkling with flashes of gunfire as they sent salvos of shells high overhead to pound the rear defences of Hitler's Atlantic Wall.

For the men manning the pill-boxes and strongpoints along the beaches of Normandy on that 6th day of June in 1944, the threat was more immediate. Even as the roar of the bombers died away and the dust of their bombardment still hung in the air, Allied infantry swarmed ashore and amphibious tanks churned across the open beach. Those Germans who could still stand, fought back with the courage of desperate men, manning their tiny fortresses to the last.

Hitler had said that the Allied invasion must be stopped at the beaches. He boasted that where a German soldier once stood, no other soldier would ever stand again. He would allow no army to drive the Germans from their newly-conquered lands. But his much vaunted Atlantic Wall, part of the Festung Europa (Fortress Europe) which had been built to defend Hitler's new lands, was neither complete nor capable of resisting an attack like the one which the Allies launched in 1944.

Two years earlier, in 1942, Field Marshal von Runstedt, the man who had

During the Second World War defence engineers had a new problem to bear in mind. Attacks now came from a new direction — from the air. Special ground attack planes were developed to keep down anti-aircraft fire. In reply the ack-ack gunners sheltered inside special anti-aircraft forts like the British one (left) which defended a nearby naval installation.



led Germany's blitzkrieg attack on France, was put in charge of defences. It was a strange choice of commander. The Fuehrer put his faith in concrete and steel to meet the threat of an Allied invasion, but Runstedt had already outflanked France's Maginot Line of static defences back in 1940. He was hardly likely to have much faith in fortresses like those which he had himself defeated.

SUNKEN FORTS

The French Maginot Line and Hitler's Atlantic Wall had much in common. In 1930 France started to build a line of fixed defences along her German frontier. The Maginot Line was certainly a strong line of defence. Some of its forts were sunk 200 feet in the ground with subterranean living quarters, stores, communications centres and railways. In addition, the air pressure was kept high to stop poisonous gas from seeping in.

All that could be seen on the surface were steel turrets and acres of concrete. Around and between the main forts were minefields, tank traps, barbed wire and communications trenches. It was an amazing piece of engineering, but it had one outstanding flaw — it simply was not long enough.

The Maginot Line stretched from Switzerland to the Belgian frontier and there it stopped. Germany's planned invasion of 1940 came through Belgium. To overcome the Maginot Line, all the Germans had to do was to simply by-pass the superb defences of the Line and force the French to fall back behind them.

Much of the Maginot Line's equipment was later taken to strengthen Germany's

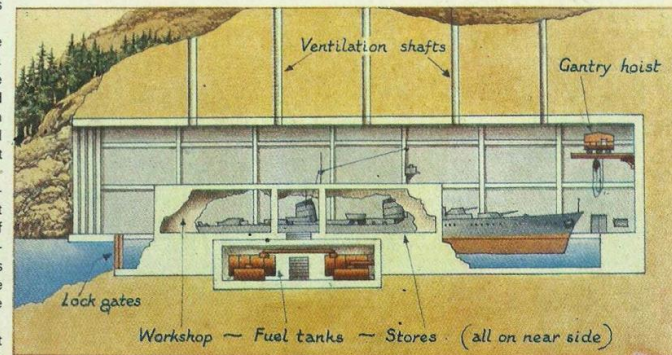
Atlantic Wall — but the Atlantic Wall, like the Maginot Line, was never finished. Its strongest section stretched from Antwerp to Le Havre, but as the Allies landed in Normandy, the work of nearly a quarter of a million conscript and slave labourers was wasted.

During the Second World War defence engineers had a new problem to bear in mind. Attacks now came from a new direction — from the air. The thousands of air-raid shelters that once littered town and country have now mostly disappeared. In their own way, air-raid shelters were strongpoints built to protect those inside from enemy fire.

More obviously fortified were steel and concrete heavy anti-aircraft gun sites. Aircraft, too, had to be protected when on

CONTINUED ON NEXT PAGE

Aircraft themselves had to be protected while on ground. Special blast pens were built for the RAF's fighters during the Battle of Britain like those at Kenley in Surrey shown above. A bomber had to make a direct hit to destroy an aircraft housed in such a pen. In Sweden, millions of cubic feet of granite have been blasted out of the country's rocky coast to make underground submarine pens, workshops, depots and even docks. Submarines and even destroyers could be kept safe from air-raids in these docks. More than a direct hit from a bomber would be needed to hit this ship of the Swedish navy, shown below.



the ground. Earth and brick blast-pens around the edge of a military airfield were simply safe parking bays for aircraft so these too, could be considered forms of defence.

The question which many people ask today is, do we still need fortifications and fortresses now that we live under the haunting shadow of nuclear weapons? After all, what could man possibly build to resist a nuclear attack which is designed to obliterate whole countries in a matter of minutes?

GRANITE DOCKS

Clearly, many people think we do still need fortresses, and engineers are now tackling the problem of devising methods of defence to resist nuclear weapons. Sweden, for example, has invested an enormous amount of time and money in hard-topped docks for her navy. Millions of cubic feet of granite have been blasted out of the country's rocky coast to make underground submarine pens, workshops, repair depots and even docks capable of housing a destroyer. In England, shelters have been dug far below ground level where, we are assured, the essential functions of government could continue even if the world above was

obliterated by nuclear attack!

In America, whole batteries of missiles and anti-missile-missiles are buried in underground silos together with their command and communications centres.

But on a less cataclysmic level are the fortifications that still abound in war-torn countries today, in which defence against nuclear attack plays no part. Israel has her Bar Lev line built of sand, steel and old railway lines in the occupied province of Sinai. The Arab states, determined not to be devastated by another Israeli invasion, have built soaring arches of concrete and earth as bomb-proof hangars for their air force interceptors.

No, the days of fortifications are not yet over. Like armies, they will probably stay with us for as long as men continue to fear their neighbours, and for as long as one power insists upon waging war on another.

**Like armies,
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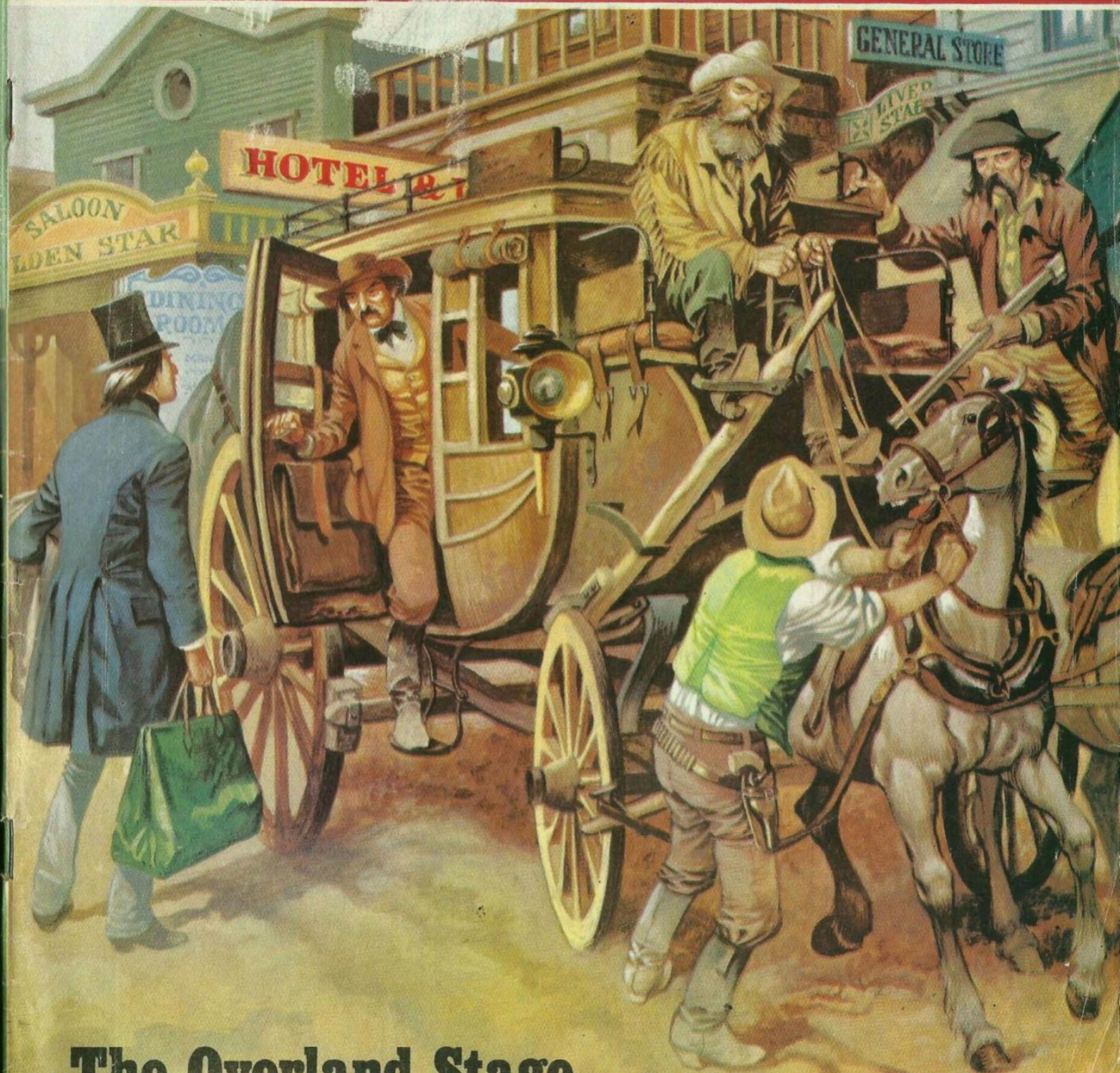
Israel's blitzkrieg attack on her Arab neighbours in 1967 led to an entirely new generation of aircraft forts. Hangars like that of the Iraqi Air Force (above) are built of concrete and earth with doors shaped to fit the aircraft. These modern hangars make it almost impossible to destroy aircraft on the ground in a sudden air-strike.

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The Overland Stage

A new series starts inside

Modern Marvels

THIS WEEK WE LOOK AT THREE NEW DEVELOPMENTS
ON LAND, SEA AND IN THE AIR

WHEN IS A SHIP NOT A SHIP?

WHEN you are handling a fast, 927 foot-long cargo ship you cannot afford to make mistakes. And gaining experience in handling such large vessels can take time. To overcome these problems the Institute for Mechanical Construction, at Delft in Holland, have installed a "super-ship simulator" for the training of ship's masters and officers.

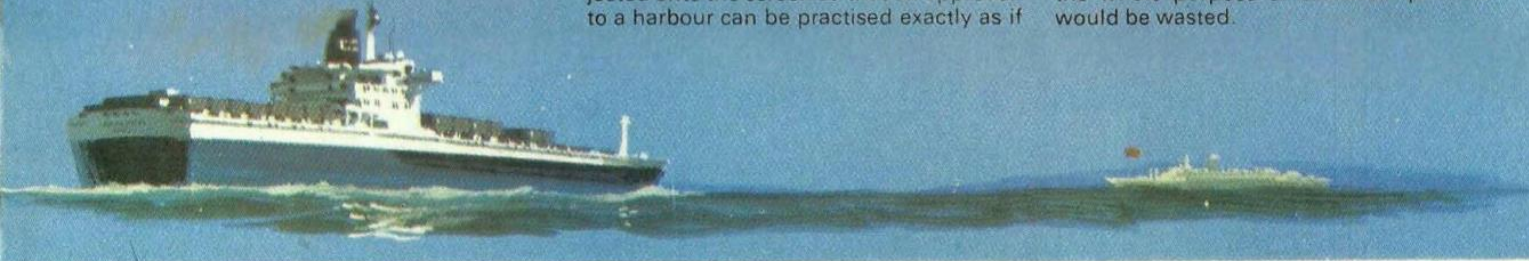
Working on the same principle as an aircraft simulator, used to train airline pilots, this three-dimensional instrument consists of a fully equipped bridge, complete with all the steering equipment, facing a large wheelhouse window. In front of this is a screen with the bow of the ship seen against a backdrop of sea or coastline. Different situations are projected onto the screen so that an approach to a harbour can be practised exactly as if

the manoeuvre were really taking place at sea.

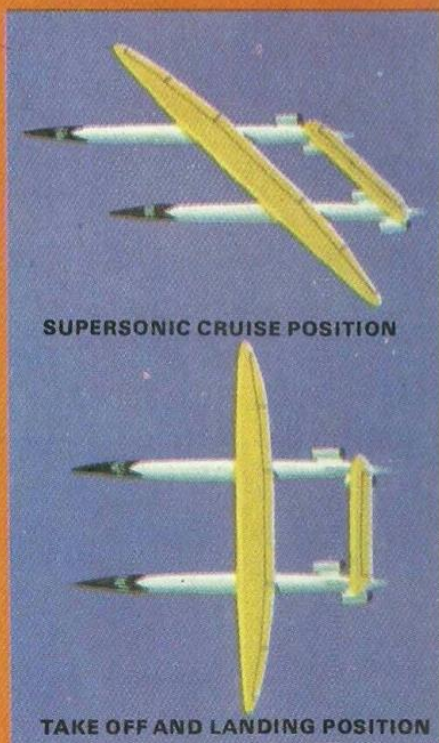
The picture is linked to the vessel's instruments so that the supposed speed and course can be accurately reproduced on the screen.

The performance of a particular ship can be fed into a computer which then gives a faithful representation of the vessel. Even crosswinds, which can react against high-sided vessels and deck cargoes can be reproduced as well as tidal effects, visibility and other weather conditions.

This high degree of realism is needed in the simulator for without it the people being "trained" would not be mentally convinced that they were at "sea" and the whole purpose of simulator practice would be wasted.



THE FLYING PARALLELOGRAM



The twin-fuselage aircraft shown in two of its flying positions.

AFTER the "swing-wing" comes the "Slew-wing" — this is the latest and radical change in wing design to come out of America.

The concept is being studied by Nasa and the Boeing Aircraft Corporation with a view to its being used for supersonic cruise airliners.

The basic design can be used on a single fuselage aircraft or on a twin-fuselage aircraft in a "parallelogram" arrangement. A wing mounted atop the fuselage, in the case of the single fuselage design, is pivoted in the centre so it can be rotated from the straight-wing position, for landing and take-off, to various oblique angles at higher speeds. Half the wing would thus be pointed more towards the direction of flight at high speeds and the other half would be trailing.

Radio-controlled models using the oblique wing principle have already been tested in wind tunnels at speeds of between Mach 0.6 and Mach 1.4.

The advantages of this type of wing are four-fold. First it would reduce the noise problem at airports because in the straight-wing position the aircraft would only need 25 per cent of the power that such delta wing aircraft as the Concorde need for take-off. Second, because the speed would be restricted to Mach 1.5, which many authorities now think to be a more realistic cruise speed than the Mach 2 proposed for Concorde, quieter engines

could be used.

Third, the wing configuration would give maximum efficiency at any speed, allowing the aircraft to operate economically over land at Mach 1.3, a speed range that would not produce a sonic boom and therefore public criticism. The aircraft could then accelerate to Mach 1.5 over the sea.

Fourth, at its cruise altitude of 40,000 feet it would also avoid criticism on the question of atmosphere pollution.

Of course, the very idea of a "slew-wing" aircraft is against all the accepted principles of aircraft design. Any aircraft you study has a symmetric or mirror-image shape. That is to say it looks exactly the same on either side of a centreline down the fuselage.

Despite its strange shape such a wing configuration would create no problem when it came to flying the aircraft.

Initial tests with flying models have employed two fuselages connected across by a wing and horizontal tail in a parallelogram arrangement. Although the results of these tests now indicate that a single fuselage with a swivelling wing fitted to the top might have greater stability, the double fuselage has not been ruled out and now both approaches to the problem are being studied. Who knows, in future the slew-wing or even the "flying parallelogram" may become a reality!

